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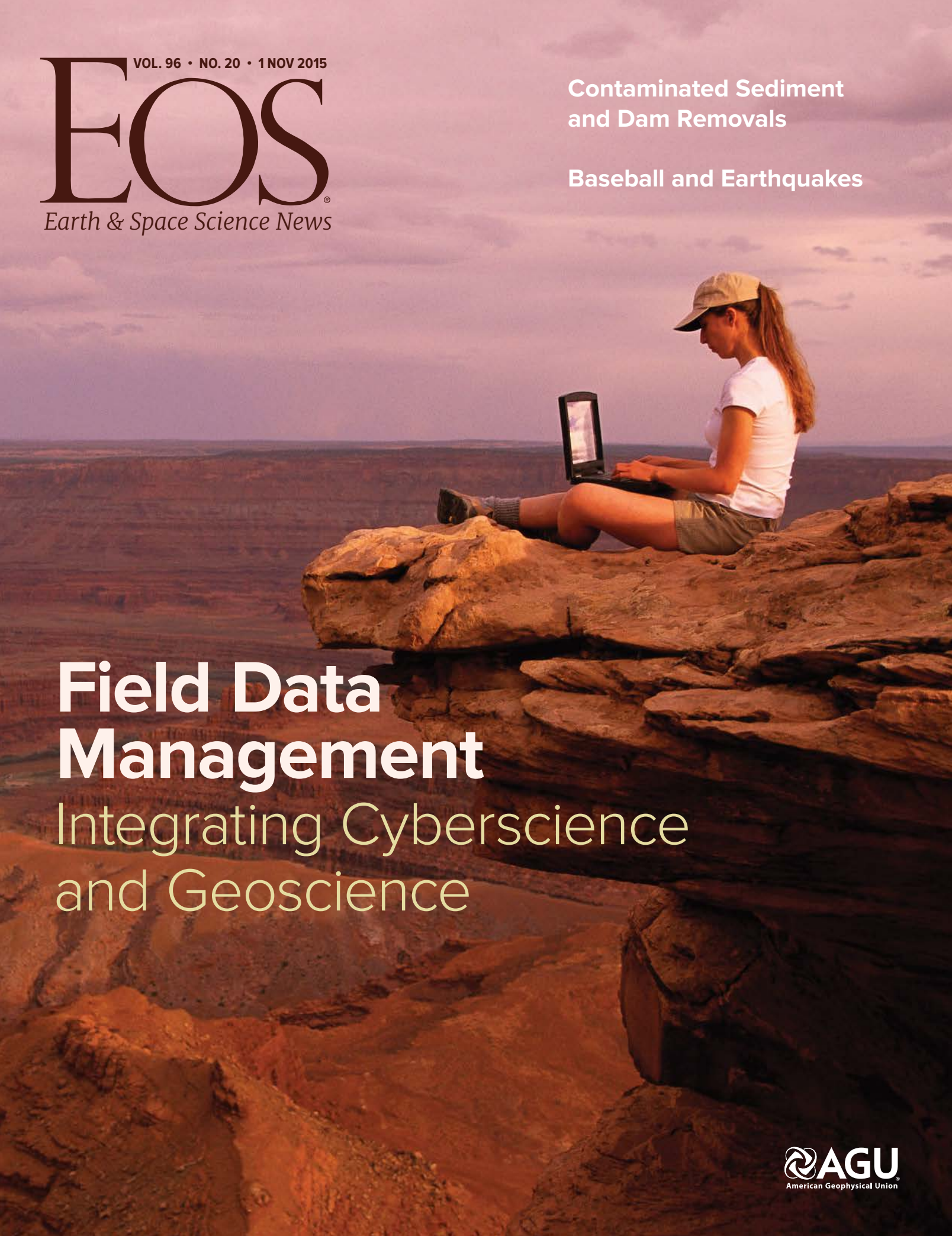
EOS

Earth & Space Science News

Contaminated Sediment and Dam Removals

Baseball and Earthquakes



Field Data Management

Integrating Cyberscience and Geoscience

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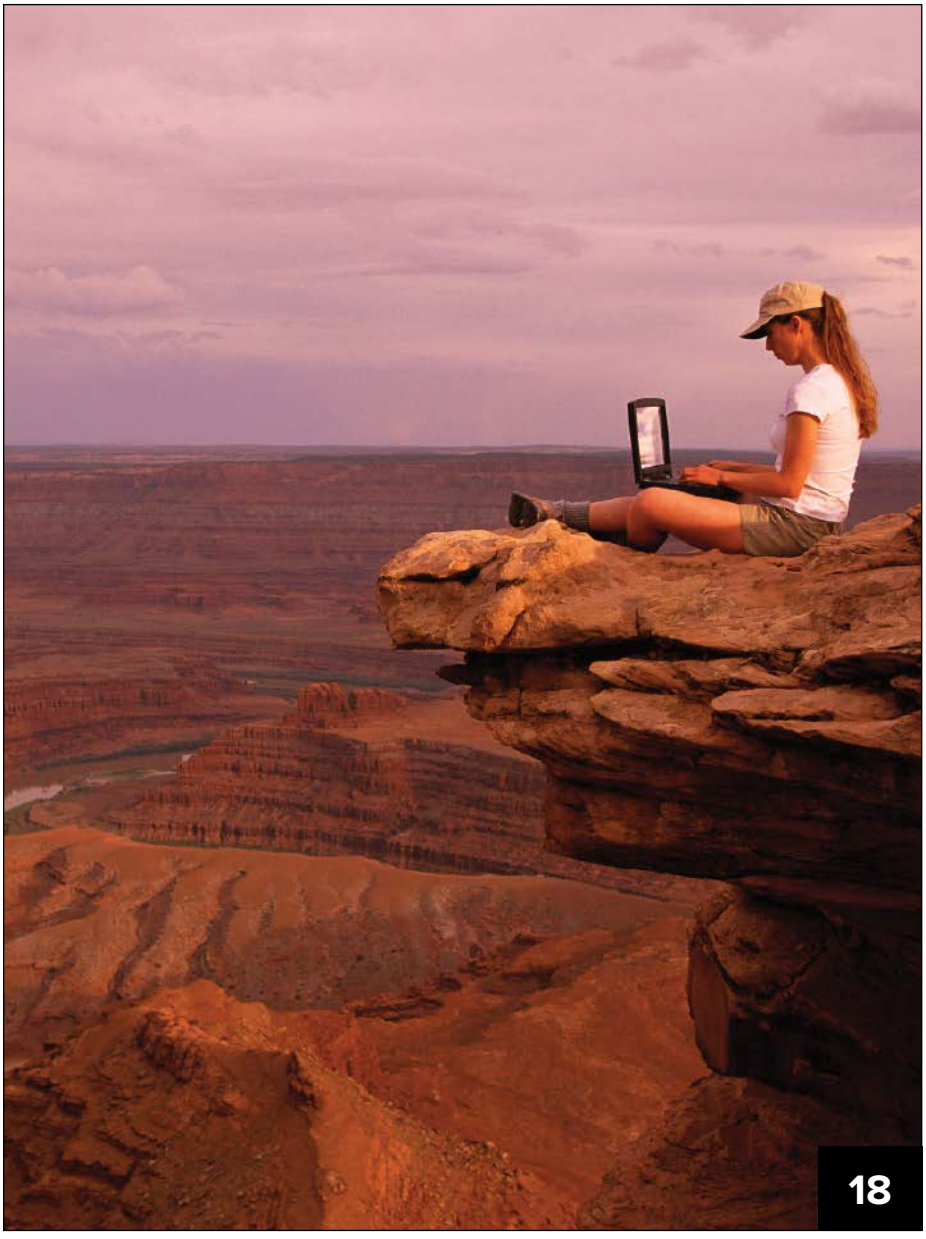

COVER

Field Data Management: Integrating Cyberscience and Geoscience

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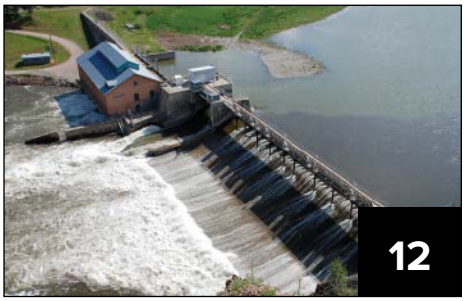
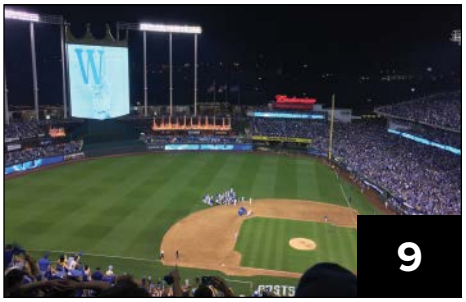


Contaminated Sediment and Dam Removals: Problem or Opportunity?

Restoring rivers to their free-flowing state promises a host of environmental benefits, but contaminated sediments may cloud the picture.

OPINION



My Life in Baseball and Earthquakes

How earthquakes interrupted a Royals game and thrust the author into a whirlpool of politics, media, and law.

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36 Spacecraft Records Rising-Tone Magnetosonic Waves

A rising tone in wave frequencies suggests a complicated, nonlinear series of interactions between electromagnetic sound waves and protons near the magnetic equator.

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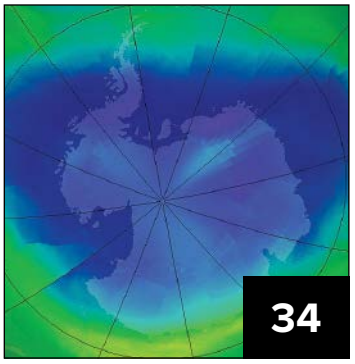

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Christine W. McEntee, Executive Director/CEO

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Report Urges Fewer Regulations on Federally Funded Research

Tony Oney

Researchers work with seismic equipment to track meltwater running through Alaska's Yahtse Glacier. Federal funds support a vast array of research, including partially supporting this University of Texas at Austin project. A new report by the National Academies of Sciences, Engineering, and Medicine calls for reducing regulations on federally supported research because of excessive bureaucratic burdens they place on scientists.

The United States must reevaluate its requirements for researchers to win and keep federal funding, says a new report released on 22 September by the National Academies of Sciences, Engineering, and Medicine.

The report, titled "Optimizing the Nation's Investment in Academic Research: A New Regulatory Framework for the 21st Century: Part 1," addresses concerns among the nation's scientists that cumbersome regulations for acquiring federal funding take too much time away from the research itself as well as from teaching and from interacting with the public with regard to science (see http://bit.ly/Regs-Report).

Although the report stresses that government regulations have improved safety at scientific institutions and made institutions more financially accountable, "increasing federal regulations have hindered the output of the remarkable research enterprise that rose from government-academic partnership," said Larry Faulkner, president emeritus of the University of Texas at Austin. He chaired the committee that conducted the study, which included input from federal agency representatives, scientists, clinicians, ethicists, public policy experts, and officials from universities that have received federal funding.

"In effect, we may jeopardize our nation's leadership in science, technology, and the social and behavioral sciences, all of which contribute to the nation's security, health, education, and well-being," Faulkner continued.

Expanding Regulations

"In a general sense, I find it kind of a breath of fresh air," John Geissman, head of the Department of Geosciences at the University of Texas at Dallas, told *Eos*. Geissman, who is editor in chief of *Tectonics*, an AGU journal, views the National Academies report as a well-deserved "recognition of the problem of far too much time being spent on a lot of bizarre rules and regulations that are associated with conducting federally sponsored research."

For instance, Geissman said, researchers must reapply for National Science Foundation grants every 3 years, putting undue stress on scientists working on longer-term projects.

Regulations for federal funding have increased dramatically in recent decades, said Harriet Rabb, the committee's vice chair and the vice president and general counsel for Rockefeller University in New York, N.Y. For example, in the 1990s, the government established about 1.5 new regulations every year. From 2003 to 2012, however, this number rose dramatically to 5.8 new regulations every year. Some of these regulations, Rabb said, can be traced back to a single isolated incident and not problematic trends. Besides tightening controls on spending and safety, funders have sought to combat scientific misconduct.

"Our committee found that this continuing growth of the federal regulatory system requirements diminishes the effectiveness of the nation's investment in research," Rabb said.

Analysis and Recommendations

The report addresses grant writing and reporting requirements of universities and federal agencies as well as agency policies and laws related to research funding.

Among its main findings, the report concludes that continuing to expand regulations is harming rather than helping academic research by shifting researchers' time from scientific endeavors to administrative tasks. Oftentimes, researchers apply for federal funding from multiple agencies, which can have redundant requirements, forcing researchers to redo the same work multiple times.

"These expanding requirements are diverting investigators' time away from research and education and directing it instead to administrative tasks that may be inconsistent, duplicative, or unclear," Rabb said.

Possible Solutions

The committee laid out ways in which Congress, federal agencies, research institutions, and universities could relieve research funding applicants of excessive administrative burdens.

The report recommends extensive Congressional review of agency grant proposal forms and a one-size-fits-all conflict of interest policy for all agencies. It urges streamlining and coordination of regulations among federal agencies to dispel redundancies and save time. Additionally, the report calls on Congress to create an entirely new body, the Research Policy Board, tasked with guiding and coordinating how federally funded research is regulated. The report recommends that institutions and universities review their own internal policies, which tend to further encumber researchers' bids for funding.

One recommendation about streamlining grant proposal processes by making them uniform across agencies and shortening their length particularly resonated with Geissman, who said it would be a "huge help."

"No matter what is being attempted to be done," he concluded, "it will be very, very useful overall."

By **JoAnna Wendel,** Staff Writer

Engineering Climate Change Resilience into New York Subways

MTA, CC BY 2.0 (http://bit.ly/ccby2-0)

Hurricane Sandy drove enough water into Manhattan's South Ferry subway station to submerge the escalators.

New York City doesn't want to relive Hurricane Sandy, and officials know it's only a matter of time until another big storm hits. The city's subway authority is making plans to fortify buildings to prevent a repeat of flooding that crippled the system in 2012. An engineer described some of those retrofitting plans at a first-of-its-kind meeting this week on the resilience of transportation systems in the face of climate change (see http://bit.ly/transport-resilience).

Sandy struck New York City in October 2012 with winds blowing 75 miles per hour (120 kilometers per hour). Some parts of New York City saw almost 14 feet (4.2 meters) of flooding as the storm pushed water inland. The hurricane killed 285 people from the Caribbean to New England, 49 of them in New York.

During those chaotic hours, water poured down into the subway tunnels that connect Manhattan to Brooklyn, Queens, and the other boroughs of the city. Seven tunnels under the East River flooded, closing subway lines for days. One tunnel was closed for more than a year as it underwent $250 million in repairs.

Batten Down the Fan Plants

Hoping to avoid a repeat of that destruction, New York's Metropolitan Transportation Authority (MTA) hired the engineering firm Arup to retrofit buildings called fan plants. These provide ventilation for the underground rail system but also gave Sandy-driven water a way to reach tunnels.

Now the plans for those renovations are done, and Tim Savery, an engineer with Arup in Edison, N.J., who worked on the designs, has described the project at the conference in Washington, D.C.

The 16–18 September meeting, organized by the Transportation Research Board, an arm of the U.S. National Academies of Sciences, Engineering, and Medicine, brought together an international mix of engineers, researchers, and government officials to talk about adapting transportation infrastructure for extreme weather and a changing climate.

Planning for future weather was the biggest topic of discussion at the gathering. Engineers and infrastructure planners are increasingly turning to climate modelers to ensure that their designs will withstand extreme weather in coming years. And climate researchers are fine-tuning their models and learning how to adjust them to inform those decisions better.

Air Yes, Water No

Fan plants blow fresh air into subway tunnels while removing exhaust. They're built over air shafts leading from the surface to the tunnels below, which can be as deep as 180 feet (55 meters) below the surface. The fan plants have vents to allow air in and out—through which Sandy's storm surge entered the tunnels below.

The MTA included fan plants in a 2013 announcement of its intention to refit subway stations and other parts of the system (see http://bit.ly/MTA-Plan).

Most of New York's fan plants saw only about a foot (30 centimeters) of flooding during Sandy, although even that was enough to send water down into the train tunnels. Per MTA's orders, however, Arup engineers have designed retrofits for the sites to keep out water 12 times that deep. Protection against 12 feet (4 meters) of flooding should accommodate the storm surge from a category 2 hurricane, plus offer a 3-foot (1-meter) margin of additional protection. Sandy was rated as a category 1 storm when it reached New York.

Case-by-Case Corrections

Savery explained that his group created different solutions for each plant. In the worst case, at least one of the plants would be completely submerged. At that site, floating gates will automatically lift to cover air vents as waters rise.

At another, engineers designed a wall 12 feet (4 meters) high to surround the building, with doors that can withstand the pressure of a flood. At that location, the group also plans to tie the building down lest it float away during a storm because parts of it aren't anchored to the air shaft below.

Redundant systems and additional lines of defense will make flooding even less likely, Savery said, adding that work at the fan plants could start next summer.

Focusing on individual structures is just one way to approach the problem of storm surges, according to Mathew Mampara, an engineer with the firm Dewberry, which is based in Fairfax, Va. But he says more expansive solutions—like flood gates that could close New York harbor completely—require money and support that isn't readily available.

"Until there is political will and resource allocation for larger projects, an asset-specific approach makes sense and is what we have to do," Mampara says.

By **Sam Lemonick,** Freelance Science Journalist, email: sam.lemonick@gmail.com

Birds Ignore Volcano Blast, Puzzle Scientists

Sam Fowler, CC BY-NC-ND 2.0 (http://bit.ly/ccbyncnd2-0)

An Andean condor soars over a canyon in Peru.

It's impossible to read a condor's mind, but you'd think a fiery volcano pouring millions of tons of ash onto its home would make the bird turn tail and head for greener pastures. You'd also assume that if that same ash killed hordes of livestock—a carrion-eating condor's main meal—it might take advantage of the carnage.

So it came as a big surprise to a group of behavioral ecologists when Chile's nearby Puyehue–Cordón Caulle volcano complex suddenly erupted in 2011 and the Andean condors they were already studying neither fled nor feasted.

"The condors seemed not [to] have noticed that something [was] different around them," Pablo Alarcón of the Universidad Nacional del Comahue in Argentina told *Eos*. He's the lead author of a recent paper detailing the birds' response—or lack thereof—to the eruption, which not only killed livestock but grounded flights around the world and threw Patagonian farmers into economic despair. "The condors' response is not common in the ecological and behavioral literature," Alarcón said. "How is it possible that condors had not escaped from those conditions?"

Alarcón and his colleagues published their observations on 5 August in *Behavioral Ecology* (see http://bit.ly/Volcano-Condors).

Explosive Interruption

Prior to the eruption, scientists had already equipped 10 condors with electronic tags that allowed them to monitor the birds' movements to better understand their breeding and other behavior. After the eruption began in June of 2011, the researchers tagged 10 additional birds and tracked their movements as well for the next 2 years using GPS data. They expected that the birds would avoid the huge ash plumes, abandon their mountain nesting sites altogether, or change their feeding patterns to target the areas where more dead livestock lay.

Because eastward winds pushed the ash over Patagonia, where the condors feed, "in this sense, foraging condors were inside the eruption," Alarcón said.

But while hundreds of thousands of cattle, goats, and sheep succumbed to blindness, tooth abrasion, digestive problems, and, eventually, death because of the abrasive ash, the condors flew head first, apparently unperturbed, through ash plumes between their nests high in the mountains and their feeding grounds along the Patagonian Steppe. The scavengers even ignored the smorgasbord of livestock carcasses that littered the steppe, instead regularly revisiting their usual feeding grounds.

Birds Versus Volcanoes

Research on how birds react to volcanic eruptions is thin. In 2010, researchers investigated seabird populations on Kasatochi Island in the Aleutians after the stratovolcano unexpectedly let loose in 2008 and covered some of the island in 30 meters of ash (see http://bit.ly/Kasatochi). The majority of bird species that did not perish immediately returned to the island after three major eruptions of the volcano but weren't able to reproduce because their nesting grounds had been buried by ash. By 2009, the researchers found that only some sea lions and a few bird species remained on the island.

Similarly, the eruption of Mount St. Helens in 1980 in southwestern Washington state wiped out most of the surrounding wildlife, including several bird species that lived around the volcano—although some species were able to repopulate the area within days or weeks of the eruption.

Although researchers have studied how other bird populations react to volcanoes, this study is the first to track the movement of individuals before and following a catastrophic eruption.

Perception or Reaction?

Alarcón and his colleagues propose that the condors stayed true to their flight patterns and home ranges because finding new breeding and feeding grounds wasn't worth the cost. Andean condors are social creatures, and mated couples raise only one chick every 2 or 3 years. Remaining in a familiar territory may be more important to them than avoiding

Remaining in a familiar territory may be more important to them than avoiding potentially dangerous ash falling from the sky.

potentially dangerous ash falling from the sky, the authors suggest.

This explanation seems like a stretch to Charlie Crisafulli, an ecologist at the Pacific Northwest Research Laboratory in Olympia, Wash. He studies how animal populations react to and recover from natural disasters such as volcanoes, and he wasn't involved in the research.

"[The authors] speak of the animal making decisions based on perception," Crisafulli said, but the birds are merely "responding to immediate experiences," such as pain.

A condor flying through an ash plume won't change course unless its eyes are "burning like hell" or it experiences any number of other volcano-related discomforts, such as difficulty breathing due to choking ash, Crisafulli asserted.

Regardless, he said he considered the observations a solid contribution to a growing body of work on how organisms behave following a volcanic eruption.

Long-Term Prospects

The chance to observe condors affected by an eruption "fell right into their laps," Crisafulli said of Alarcón and his team. "They took advantage of this opportunity by conducting a well-thought out and interesting study."

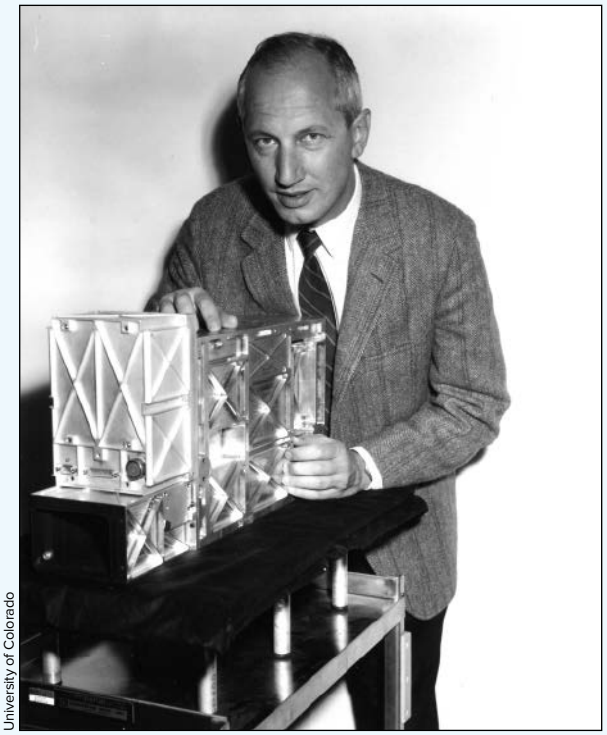
How the birds will fare in the long run remains to be seen, Crisafulli noted—a question the authors also address in the paper. They raise the possibility that the condors exposed to the eruption might suffer long-term detriments such as silicosis (a lung disease) or chemical contamination.

By **JoAnna Wendel,** Staff Writer

AFP Photo/Claudio Santana

Ash billows from Puyehue volcano in southern Chile on 5 June 2011, the day after the volcano erupted for the first time in 50 years, prompting evacuation of 3500 people. Ash from the eruption reached Argentina.

Charles A. Barth, 1930–2014



University of Colorado

Professor Charles Barth holds the quarter-meter Ebert-Fastie grating spectrometer that flew on Mariner 6 and made successful flyby observations of Mars. The spacecraft reached its closest approach on 31 July 1969.

He was among the first researchers to recognize the importance of nitric oxide in the Earth's upper atmosphere.

Accomplished space researcher Charles A. Barth died at his home in Boulder, Colo., on 14 October 2014, at the age of 84. Charles directed the Laboratory for Atmospheric and Space Physics (LASP) of the University of Colorado Boulder (CU-Boulder) from 1965 to 1992. He was among the first researchers to recognize the importance of nitric oxide in the Earth's upper atmosphere and its significance to ozone and water vapor. Numerous students he taught at CU-Boulder and others from the university community remember him as a devoted teacher and mentor.

Charles spent his childhood in Philadelphia and went on to study chemistry at Lehigh University, receiving his B.S. in 1951. After serving in the U.S. Air Force, Charles got a Ph.D. in 1958 from the University of California, Los Angeles. He was then awarded a National Science Foundation postdoctoral fellowship to conduct research at the University of Bonn in Germany, from 1958 to 1959. Returning to the United States, Charles worked as a research physicist for the next 6 years in NASA's Jet Propulsion Laboratory (JPL) at the California Institute of Technology in Pasadena.

30 Years Leading LASP

When Charles was named director of LASP in 1965, he and his wife, Louise, who met each other in Los Angeles during Charles's graduate studies, moved their family to Boulder. Charles's steadfast and innovative leadership at LASP would span nearly 3 decades. Even after retiring, he remained a committed ambassador for LASP and maintained a humble presence in the laboratory hallways.

Charles's focus on planetary atmospheres included Earth's middle and upper atmosphere. Of 140 papers Charles published, approximately one-quarter addressed nitric oxide, including his last paper published in 2010. Many of his doctoral students continue similar studies today.

Principal Investigator on NASA Missions

Charles played a leading role in the development of spaceborne ultraviolet spectrometers, small spacecraft platforms, and planetary exploration systems. Under his guidance, LASP science instruments journeyed to every planet in the solar system. Charles served as the principal investigator for experiments on 16 NASA missions and flew dozens of new instruments on 59 sounding rocket (suborbital) flights. These missions included Mariners 5, 6, 7, and 9; Orbiting Geophysical Observatories 2, 4, 5, and 6; Atmosphere Explorer C and D; Apollo 17, Pioneer Venus, Solar Mesosphere Explorer (SME), Galileo, Cassini, and Student Nitric Oxide Explorer (SNOE).

With the SME and SNOE missions, Charles demonstrated how to effectively develop and manage research missions. The Solar Mesosphere Explorer team operated a NASA mission entirely from a university for the first time, and LASP's tradition of conducting missions with a combination of professional staff and students still thrives today. Charles built many Ebert-Fastie grating spectrometers, such as the Mariner 6 spectrometer he holds in the photo.

Charles participated extensively in helping guide the space research community. He served on NASA's Space and Earth Science Advisory Committee (1982–1985) and the NASA Advisory Council's Solar System Exploration Committee (1980–1987).

Awards and honors he received include the AGU Nicolet Lecture (1999), JPL's Distinguished Visiting Scientist appointment (1995), the NASA Distinguished Public Service Medal (1983), the NASA Exceptional Scientific Achievement Medal (1972), and the University of Colorado Robert L. Stearns Award (1970).

Inspiring the Next Generation

In addition to his long and productive research career, Charles left a lasting legacy through his teaching and mentoring. He began teaching in 1965 at CU-Boulder as an associate professor. In 1967, he advanced to full professor of astrophysical and planetary sciences. In 2002, he became professor emeritus.

Charles generously shared his knowledge and passion, inspiring both colleagues and students while developing the next generation of space science researchers to carry forward the work. He served as the primary adviser for nearly two dozen doctoral students at CU-Boulder. In addition, he inspired countless undergraduates studying science and engineering. Through his commitment to hands-on education and training, Charles involved many students in his space research and NASA missions. Today, students still receive hands-on experience designing and operating spacecraft at LASP.

Charles's passion for teaching extended beyond the university campus. He volunteered with the Boy Scouts of America for many years. He shared his love of the majestic Colorado Rocky Mountains through camping and hiking with the Scouts and with his family. His children fondly recall family projects—fueled by their dad's love of science and technology—that included building televisions, radios, and garage door openers.

In 2013, CU-Boulder established the Charles A. Barth Scholarship in Space Research. The university awarded the first Barth scholarship to CU-Boulder student Wren Suess, shortly before Charles's death.

Charles's wife of 60 years, Louise, and four children survive him. We will miss seeing Charles in the halls of LASP and discussing the latest research discoveries with him. His achievements in space research will be forever etched in NASA's and LASP's history.

By **Daniel N. Baker** and **Thomas N. Woods,** Laboratory for Atmospheric and Space Physics, University of Colorado Boulder, Boulder; email: daniel.baker@lasp.colorado.edu

Sharing Climate Information in the Himalayas

International Conference on Climate Change Innovation and Resilience for Sustainable Livelihood (ClimDev15 Conference)

12–14 January 2015, Kathmandu, Nepal

Jeeban Panthi

An automatic weather station at Langtang Mountain in Nepal Himalaya measures and transmits weather data in real time. Information from this and other stations could be placed on a data-sharing portal so that users will have easy access to information on shifting weather patterns, climate predictions, and predictions of disease outbreaks.

The Intergovernmental Panel on Climate Change has identified the Himalayan region as a "white spot"—a place devoid of meaningful data—because of the lack of climate and impacts information. Both the sparsity of measurements and lack of long-term continuity of hydrologic and climatic observations contribute to data gaps in the Himalayan region. Faced with increasing climate uncertainty in the region, scientists maintain that it is essential to develop a regional data-sharing mechanism to guide collective mitigation and adaptation efforts.

To this end, scientists from 27 countries and multiple disciplines gathered in Kathmandu, Nepal, in January 2015 for the International Conference on Climate Change Innovation and Resilience for Sustainable Livelihood. Participants agreed that the scarcity of long-term data sets could be partly addressed by a common regional data portal, which would also focus on quality assurance. They also identified better communication and information dissemination as goals at the conference.

Data Access for All

Discussion focused on how community planners need to have access to data pertinent to their fields to make informed decisions about factors such as weather hazards, flood and drought events, and the potential for disease outbreaks. In Nepal and elsewhere, many research projects have been generating scattered field data that could be made available through a common data portal that would also integrate geospatial and remote sensing information.

The biggest challenge, attendees agreed, is to provide this information to stakeholders in an understandable form. Stakeholders include farmers and herders, nonprofits and development organizations, and many other users with different expectations and levels of sophistication. As a start, the Nepal government has launched a data portal for sharing climate observations (http://www.dhm.gov.np/dpc/).

The conference featured sessions on climate extremes, water resource management, the livelihood of women and marginal groups, and policy needs for agriculture and livestock sectors. Two dedicated sessions on data gaps and potential remedies identified a pervasive inability of regional institutions to disseminate information at local and policy levels. Examples of applications discussed included early flood warning for communities and monsoon timing and intensity prediction for farmers.

Untapped Potential of Indigenous Knowledge

The participants also emphasized the importance of tapping and applying indigenous knowledge while also exploring innovative ideas. Tested traditional knowledge can be integrated with scientific findings for promoting sustainable livelihoods.

For example, heat energy tapped from farm manure to warm the water for household use in Nepal's Dhading District reduces wood consumed for fuel, thereby conserving forest. How can this be employed more broadly to conserve resources?

An Integrated Approach

Speakers presented several case studies from the region in which community action plans and training were combined with hydroclimatic monitoring and data visualization to tackle problems such as the shortage of water for drinking and agriculture, the lack of market access, poor-quality housing, recurrent erosion and landslides, and urban water contamination and the "heat island effect" whereby the heat of municipal areas creates an urban-driven warmer climate.

Attendees agreed that the ability for such approaches to scale up and be replicated should also be considered.

Action Items

Expert panelists concluded the conference by spelling out the following clear ways to better tackle climate-related problems in the Himalayas:

- Include community-level knowledge.
- Translate research findings into user-friendly forms for effective application.
- Connect and collaborate with all stakeholders in both the private and public sectors.
- Build a collaborative data exchange platform.
- Organize a consortium for high-altitude observations including cryospheric changes.

The program agenda, presenter list, abstracts, presentation slides, posters, and some videos can be found on the conference website at http://climdev15.org. Madan Lall Shrestha and Dilli Bhattarai from The Small Earth Nepal (SEN) also contributed to this meeting report.

By **Jeeban Panthi,** The Small Earth Nepal, Kathmandu, Nepal; email:jeeban@smallearth.org.np; **Nir Y. Krakauer,** City College of New York, New York, N.Y.; and **Soni M. Pradhanang,** University of Rhode Island, Kingston

My Life in Baseball and Earthquakes

Taylor Buchanan

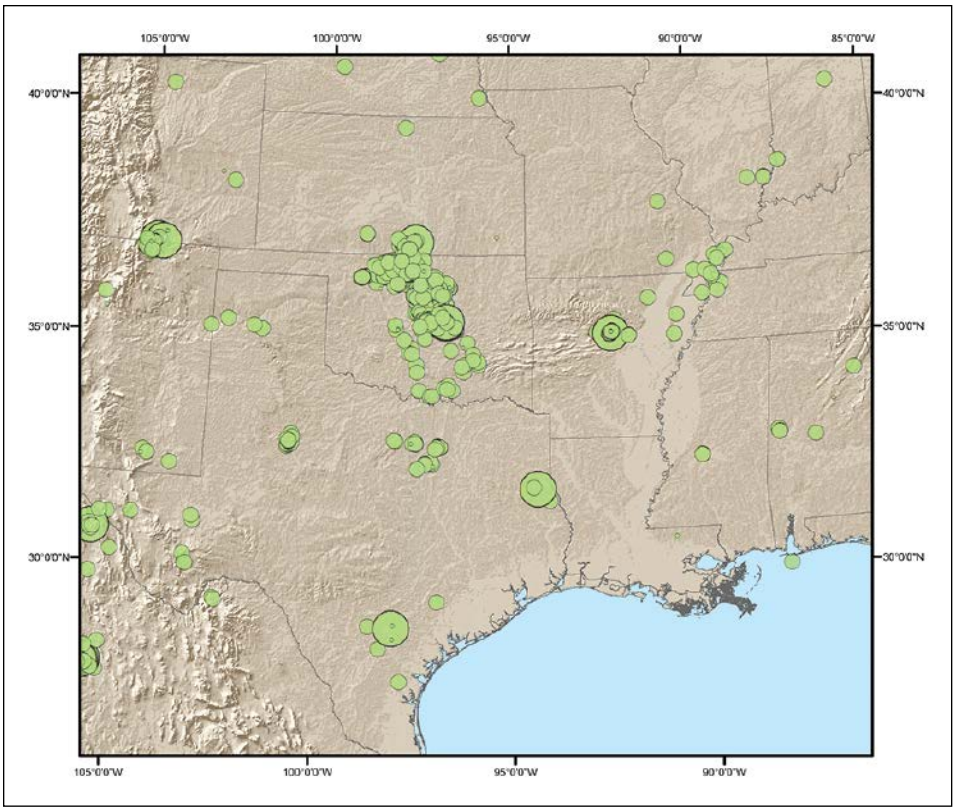
Last September, as the author and his son watched a postseason baseball game between the Kansas City Royals and the Oakland A's, the U.S. Geological Survey reported tremors in south central Kansas.

Baseball and induced seismicity: I wouldn't have expected those worlds to intersect. But one night in September 2014 they did.

I was in Kansas City, watching the Royals and the Oakland A's play postseason baseball. As the game began, my cell phone buzzed with alerts from the U.S. Geological Survey (USGS) National Earthquake Information Center: tremors in south central Kansas. For two or three innings, I read and forwarded earthquake-related emails—something not easily accomplished with a crowd of 40,000 people intent on texting, tweeting, and sending selfies to their friends, using most of the mobile phone bandwidth.

Three days later, a magnitude 4.2 earthquake shook the same part of Kansas. This was one of more than 100 earthquakes (magnitude 2 and greater) that occurred in the state in 2014. A 4.2 earthquake might not mean much in California (the 1989 World Series earthquake in San Francisco was a 6.9), but it was the largest Kansas earthquake in a long time. The day after that 4.2 earthquake, I was in Harper County, Kan., near the Oklahoma border, with Kansas Governor Sam Brownback and others, listening to local concerns and talking about induced seismicity with the county commission, three TV stations, and the public.

Establishing the causes of midcontinent earthquakes and formulating responses are a highly visible, complex, and contentious process—one that Earth science organizations must confront. In Kansas, things started get-



USGS

Fig. 1. Seismicity of the central United States, 2009 to July 2015. Green circles indicate earthquakes of magnitude 3 and larger, and their sizes reflect the size of the earthquake. Much of this seismicity is believed to be related to salt water disposal from oil and gas production, particularly in Oklahoma, Texas, southern Kansas, central Arkansas, southeastern Colorado/northeastern New Mexico, and southeastern New Mexico.

ting interesting in September 2013, when small earthquakes began occurring in the south central part of the state. In the past, Kansas seldom experienced more than one or two magnitude 3.0 earthquakes per year. In 2014, we had more than 40, including two events greater than 4.0. We had eighty-four 2.0–3.0 events, many of which were strong enough for residents to feel.

Establishing a Task Force

In early 2014, the governor of Kansas appointed an induced seismicity task force. Staffers from the Kansas Corporation Commission (KCC) and the Kansas Department of Health and Environment (KDHE), two organizations that regulate underground fluid disposal in Kansas, were joined by staff from the Kansas Geological Survey (KGS). The task force drafted a report that we submitted to the governor's office in September 2014.

Because Kansas was relatively quiet seismically until recently, we relied heavily on two USGS monitoring stations. The task force recommended increased seismic monitoring. We also developed a seismic scoring system based on magnitude, clustering (spatial and temporal), and other characteristics. When that system identifies an earthquake of a specific score or higher, KCC and KDHE compile data on disposal wells (including hazardous waste, as well as oil and gas production fluids) within 3 miles (4.8 kilometers) of the event.

By the time the task force was formed, attention in the scientific community had focused on salt water disposal wells from oil and gas production as a likely source of the seismicity. Midcontinent wells often produce far more salt water than oil—salt water that is generally injected into deep subsurface rock formations. Recent oil exploration in the area focused on rocks of Mississippian age (roughly 360 to 320 million years ago) and utilized horizontal drilling. Some of these wells produced large amounts of salt water and thus needed larger-volume disposal wells.

To be clear, the hydraulic fracturing process itself has not been directly connected to seismic events in Kansas, and it has been linked to relatively few events in the midcontinent (Figure 1). However, we differentiate between hydraulic fracturing (part of the well completion and stimulation process) and salt water disposal (part of the oil production process).

Hydraulic fracturing uses a mixture of water, sand, and chemicals under high pressure to crack open subsurface rock formations and extract oil and gas. Some of that mixture flows back up and is pumped back into deep subsurface rocks. The issue here is not flowback from hydraulic fracturing but disposing of the salt water that comes up with the oil during the production process. This salt water is produced over the entire life of the well.

Our working hypothesis at KGS postulated that the increased seismicity was related to high volumes of salt water injected into disposal wells. A small amount of the fluid initially going into these wells is flowback from hydraulic fracturing. A far larger percentage of the fluid is salt water that is produced along with oil.

Addressing the Challenge

Over the past 2 years, seismic monitoring in Kansas has improved. In April 2014, USGS installed nine seismometers in Harper and Sumner counties, then added more after a magnitude 4.9 event in mid-November 2014 (the largest recent earthquake and the largest ever digitally recorded in the state).

KGS established its own seven-station temporary seismic network in the area, initially using IRIS equipment borrowed from the University of Missouri (from a seismology consortium funded by the National Science Foundation's Industrial Research and Development Information System). This network is somewhat more widely and uniformly distributed than the USGS temporary stations. We're also installing a permanent statewide network, and we regularly receive data from the Oklahoma Geological Survey (OGS), which operates seismograph stations just across the state line.

In March 2015, KCC ordered gradual cutbacks in the volume of salt water going into disposal wells in five areas of seismic concern in south central Kansas. It's too early to know the impact of these reductions, although earthquake activity has decreased, as of this writing. At the same time, oil prices declined, and drilling in the affected area has also slowed.

With induced seismicity, KGS was thrust into a public policy debate. It's been a challenge, but one we could not and will not avoid. From fracking to climate change, the geosciences deal with some of the most important and contentious natural resource issues facing this country and the world. As politicians and regulators work through those

issues, scientists need to be part of the conversation. If we are not, we risk irrelevance and poorly informed decisions.

The public arena of induced seismicity has created its own demands. It has required dealing with the political, media, and legal worlds. Here are some lessons learned about each.

Politics

Nearly all public agencies get thrust into politics at one time or another, but induced seismicity required an unusual level of political interaction for KGS. I talked regularly with our governor on this issue. We briefed legislative committees, including one hearing that lasted for 90 minutes, most of it questions and answers.

On the local level, we met with county commissioners in the affected area and took public questions and comments. In general, the locals appreciated the economic impact of oil and gas activity in their area but also wanted the earthquakes (or at least felt earthquakes) to stop. I even did a brief update on induced seismicity as part of an American Geosciences Institute briefing for congressional staff.

Navigating these various corridors was challenging, especially when dealing with uncertainty. Politicians want clear, unequivocal answers, not more studies. They represent constituents, sometimes frustrated constituents, whom they want to please. At the same time, we had to make budget requests from these same politicians, asking for additional funding to enhance monitoring to help us understand the issue, to answer their questions, and to help guide a response.

Media

Dealing with the media—from *The New York Times* and *The Wall Street Journal* to Wichita television stations and local weekly newspaper reporters—has been equally challenging. Even in these days of social media, many people (especially politicians) pay close attention to traditional media outlets.

For the most part, reporters are responsible and work hard to clearly communicate what scientists know and don't know. When they get issues confused or describe something inaccurately, however, setting the record straight can be frustrating and time-consuming.

It's been particularly hard to communicate the distinction between salt water disposal and hydraulic fracturing as a possible catalyst of seismicity. But for the members of the media and the public who are opposed to hydraulic fracturing, this is a nuance, a distinction without a difference. I've tried to be patient with reporters and to be thicker skinned, especially when reading the online comments that follow newspaper articles.

The Legal Realm

In a recent meeting, I realized that I was the only one without legal representation. Induced seismicity creates questions of liability, government regulation, and the proprietary nature of data. Although we have long been subject to open records and open meetings laws, induced seismicity provides lessons about their intricacies and importance. The governor's task force followed open meetings requirements; I fielded an open-records request for emails. Perhaps more importantly, requests for certain data quickly raised confidentiality issues. Some 3D seismic data, for example, were unavailable because of proprietary agreements between companies.

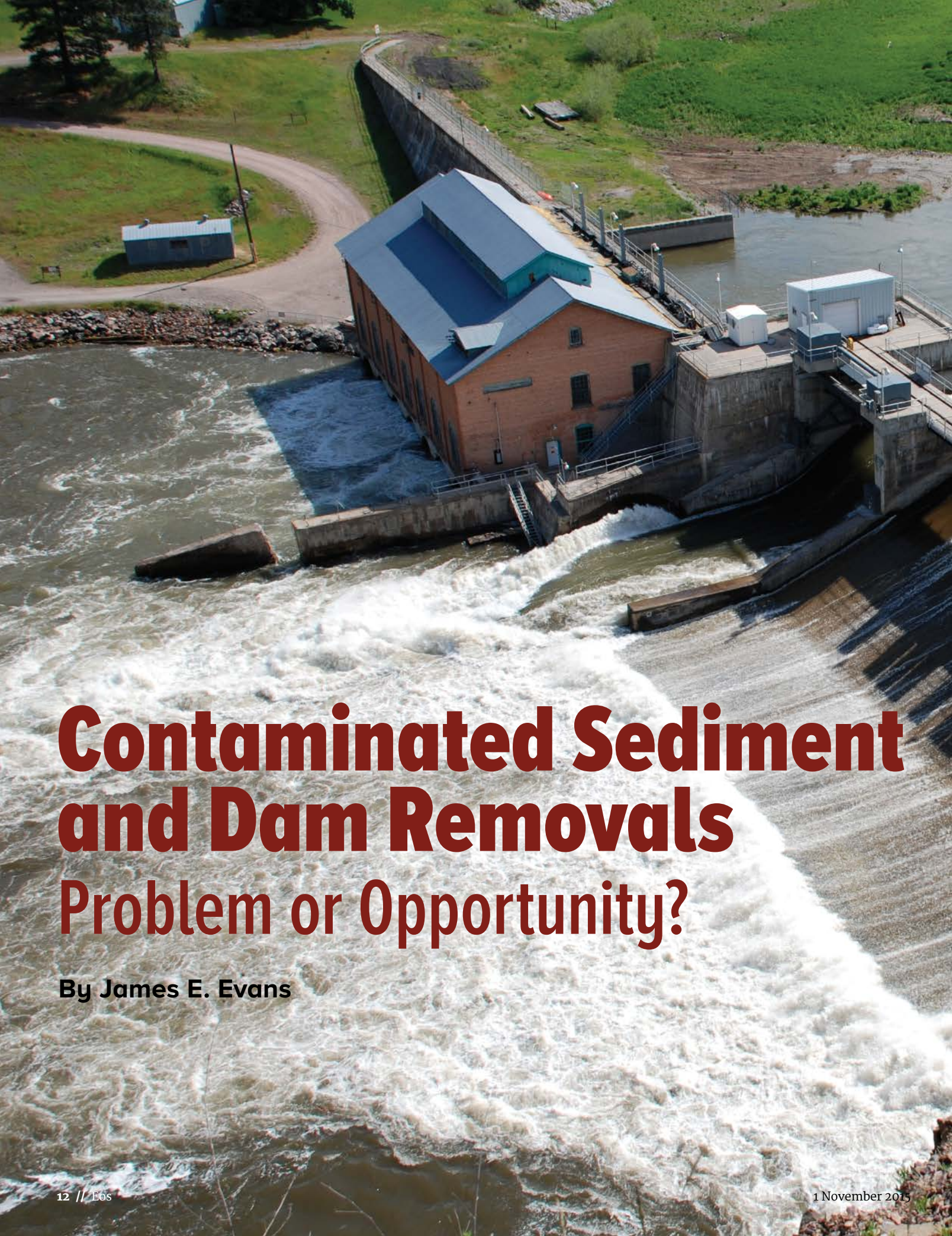
A Team of Organizations

We had to face these issues—political, legal, media—head on. We had lots of help from other Earth science organizations, especially OGS. A November 2014 meeting on earthquake risk and induced seismicity organized by OGS and USGS was especially timely. Our state regulatory agencies, KCC and KDHE, have been true partners. Work by the National Research Council, the Stanford Center for Induced and Triggered Seismicity, and the industry has also been helpful.

It's been a full year now, and we're wrapping up another baseball season. Midcontinent earthquakes continue. It's been a bumpy ride and probably will continue to be. But we're learning more all the time, especially about the effectiveness of our mitigation techniques.

And we know that research organizations like ours can work with regulators and industry to better understand seismicity, earthquake mitigation, and how to continue energy production. When we do that, we not only improve scientific understanding, we demonstrate the relevance and value of public Earth science organizations.

By **Rex Buchanan,** University of Kansas, Kansas Geological Survey, Lawrence; email: rex@kgs.ku.edu



Contaminated Sediment and Dam Removals

Problem or Opportunity?

By James E. Evans

Thomas O'Keefe, American Whitewater/Hydropower Reform Coalition. Used with permission.

Dam removal and river restoration projects can restore river health and clean water, revitalize fish and wildlife populations, provide public recreation opportunities, and boost local economies. These projects can also unleash new problems, however, if contaminated sediments are released downstream. Take the hundred-year saga of the Milltown Dam, for example.

In 1908, copper-mining tycoon William Clark built the Milltown Dam on the Clark Fork River in southwestern Montana to supply hydroelectric power to his sawmills. Within months of the dam's construction, a 500-year flood deposited tons of metal-contaminated sediment behind the dam. By the 1980s, the reservoir stored 5 million cubic meters of contaminated sediment. Arsenic levels in nearby groundwater compelled the Environmental Protection Agency to designate the reservoir a Superfund site.

During an unusually wet winter in 1996, a large ice jam flowed downstream and threatened to breach the dam. An emergency drawdown of the reservoir, intended to settle the ice jam on the riverbed, released a large quantity of contaminated sediment into the river downstream from the dam, killing most of the river's fish. This ultimately led to a multiyear remediation plan involving a phased reservoir drawdown, mechanical removal of 2 million cubic meters of contaminated sediment at a cost of $120 million, and a planned breaching and removal of the dam in 2008.

The Milltown Dam's history illustrates a collision of two conflicting environmental concepts: the use of dam removals as a tool for river restoration and the release of significant quantities of contaminated sediment in rivers, especially the archive of legacy sediment in dams and reservoirs. This conflict may play out more and more over the next decades. More than 1000 U.S dams were removed between 1975 and 2015. This pace will only continue because more than 85% of U.S. dams will exceed their 50-year engineered life expectancies by 2020 [*Bennett et al.,* 2013]. Aging dam-reservoir systems add to the impact as their sediment trapping efficiencies decline and sediment throughput increases [*Juracek,* 2015].

The Past as Prelude

Environmental policy makers and engineers have largely treated contaminated sediment as a separate issue from the effect of dam removals, with a few notable exceptions. The 1973 removal of the Fort Edwards Dam on the Hudson River released 336,300 cubic meters of sediment within the first year while retaining 765,000 cubic meters in the former reservoir [*Shuman*, 1995]. Later, scientists determined that the sediments were contaminated with polychlorinated biphenyls (PCBs), a type of pollutant banned in the United States in 1979. Eventually, workers dredged 2 million cubic meters of river sediment at a cost of $561 million after decades of legal arguments about the merits of dredging versus sediment capping.

The 2008 removal of the Milltown Dam is, to date, the most significant dam removal project involving contaminated sediment. Sediment deposits behind the dam contained heavy

The Milltown Dam just upstream of Missoula, Mont. Metal-contaminated sediment accumulating behind the dam led to a large-scale remediation effort involving a phased reservoir drawdown, sediment removal, and breaching and removal of the dam.

City of Fremont, Ohio. Used with permission.

Aerial photo of the Ballville Dam (Sandusky River, Ohio) where a planned dam removal for enhanced fishery habitat has become mired in a legal dispute about possible downstream release of contaminated reservoir sediments.

metals (arsenic, lead, zinc, and copper) from mining waste [*Evans and Wilcox*, 2014]. By the 1980s, the reservoir stored 5 million cubic meters of contaminated sediment. Studies demonstrated that the reservoir sediments were no longer a contaminant sink but a contaminant source.

Between initial reservoir drawdown in June 2006 and dam breaching in March 2008, 140,000 metric tons of fine-grained sediment containing 44 metric tons of copper and 6.4 metric tons of arsenic eroded from the reservoir and transported downstream. In the year following the dam removal, 420,000 metric tons of fine-grained sediment containing 169 metric tons of copper and 15.8 metric tons of arsenic eroded from the former reservoir [*Sando and Lambing*, 2011], despite the preremoval remediation.

Before and After

For smaller dams, there are two case studies with preremoval and postremoval geochemistry data. After the 2000 removal of the Manatawny Creek Dam in Pennsylvania, *Ashley et al.* [2006] showed that downstream sediment transport reduced the number of sites in the reservoir where polycyclic aromatic hydrocarbons (PAHs) and PCBs exceeded the probable effects level [*Ingersoll et al.*, 1996] within several months after removal.

In the 2011 dam removal on the Pawtuxet River near Cranston, R.I., *Cantwell et al.* [2014] used sediment traps and passive samplers to document reductions in dissolved and particulate PAH and PCB concentrations. Both studies showed that dam removal had minimal downstream effects because of low initial volumes of fine-grained sediment in the reservoir.

Contaminated sediments have been a concern in the ongoing removals of the Ballville Dam (Sandusky River, Ohio), the Brown River Dam (Boardman River, Michigan), the Otsego Township Dam (Kalamazoo River, Michigan), and probably many others. In a significant policy change, the Sierra Club has sued to prevent the removal of the Ballville Dam (photo above) pending evaluation and remediation of the reservoir sediment. The concern is that release of phosphate from the reservoir would promote blooms of toxic algae (*Microcystis*) downstream in Lake Erie. In 2014, toxic algae blooms in Lake Erie cut off the drinking water supply for 500,000 people for several days. However, the lawsuit and the financial costs associated with it and any remediation may have the unintended consequence of preventing the dam removal from taking place.

The failure of a dewatering structure at the Brown River Dam caused hydraulic flood damage to 66 properties and led to the unanticipated downstream release of 5700 cubic meters of sediment containing arsenic, barium, lead, selenium, and zinc. Affected property owners filed a $6.3 million liability lawsuit that is still pending. The Otsego Township Dam removal, which took place within a PCB Superfund site, was complicated by the need to spend $725,000 repairing the dam to prevent imminent failure and release of contaminants.

As dams age and need to be removed, contaminated sediment remediation will become increasingly frequent and costly. *Major and Warner* [2008] found contaminant concentrations above threshold effects levels [*Ingersoll et al.*, 1996] at eight of the nine potential dam removal sites in New England. *Bennett et al.* [2013] found low sediment pesticide concentrations in seven of eight reservoirs. The 2009 Springborn Dam removal on Scantic River in Connecticut required spending $2.8 million, out of a total river restoration budget of $4 million, for preremoval contaminated sediment disposal.

Quantifying Contamination

Scientists have developed several ways to define and classify the degree to which sediments are contaminated. The sediment quality criterion for any particular contaminant is defined as the contaminant concentration in the sediment pore (interstitial) fluid that is equal to the water quality criterion. Scientists often use an equilibrium partitioning approach to calculate contaminant concentrations in interstitial water on the basis of sediment concentrations. However, because of data limitations and because most sediments contain mixtures of contaminants, scientists must also frequently use other classification methods.

The sediment triad approach (STA) uses sediment geochemistry, bioassays (laboratory measures of lethality of a contaminant to certain species or other parameters), and changes in structure, biomass, or diversity of the ecological community in the river [*Long and Chapman*, 1985]. STAs offer advantages, such as the reproducibility of bioassay studies, but require extensive data. Also, ecological community studies from one geographic area are unlikely to have wider applicability.

Various organizations in North America have created sediment quality guidelines (SQGs). The SQG for each contaminant is based on two reference concentrations that are statistically associated with biological effects. Concentrations below the lowest reference level are considered a minimal risk, concentrations between the two reference levels are considered threshold risk, and concentrations above the highest reference level are considered probable risk. Recently, scientists have merged several different types of SQGs into a consensus-based approach [*MacDonald et al.*, 2000].

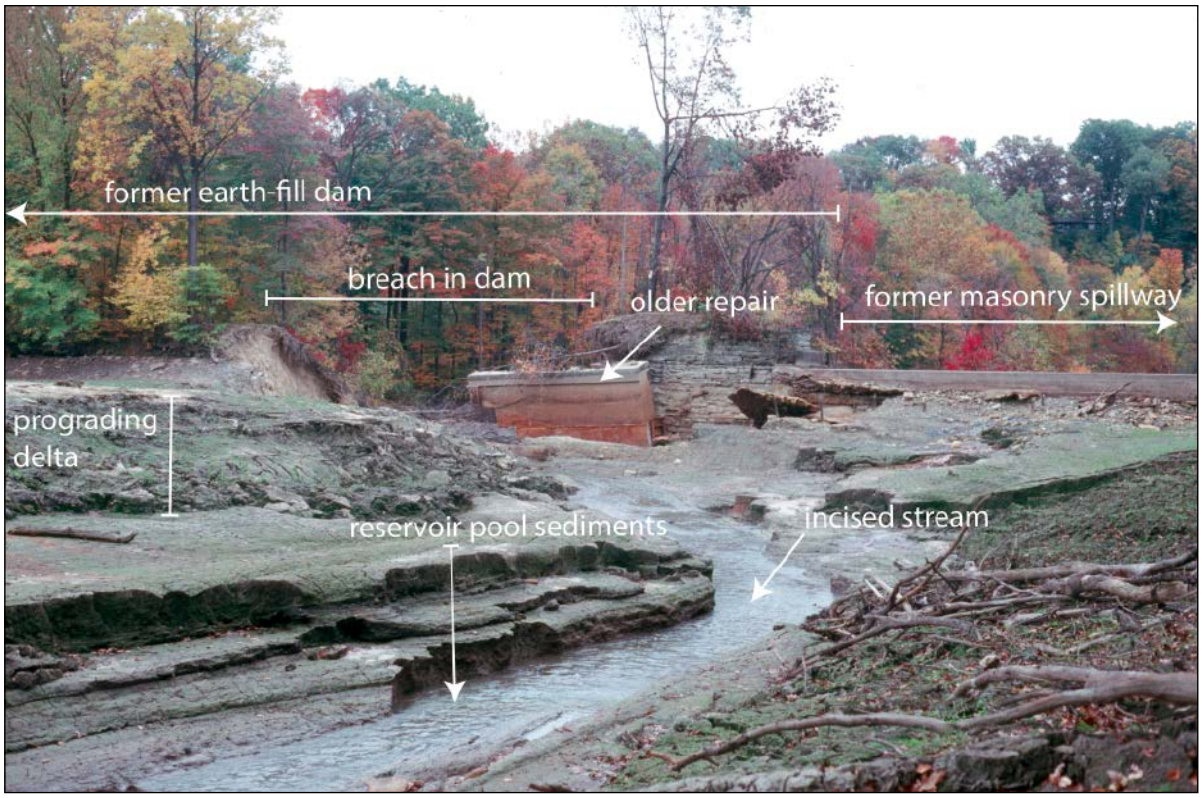
It is not clear, however, what SQGs mean in dam removal situations. First, it is not clear how preremoval reservoir sediment SQGs translate into postremoval downstream risks after the contaminants are dispersed and diluted. Variables include sediment composition (percentage clays and organic matter), transport rate, channel residence time, the dynamics of downstream reaches that might create hot spots (regions of concentrated contamination), and whether or not sediment is dispersed into the ocean or a large lake.

Moreover, the true threat of a contaminant is its bioavailability, which is not based solely on sediment concentration. Bioavailability also depends on whether contaminants are chelated to particulate organics or weakly bound to clays and sulfides and on environmental parameters affecting interactions between particulate phases and dissolved phases.

Reservoir Management Decisions

After the decision has been made to remove a dam, contaminated sediment creates problems for management plans. In a reservoir, options for managing contaminated sediment include no action (which might be appropriate if remediation, such as dredging, creates higher risks) and sediment stabilization by capping [*Randle and Greimann*, 2006].

However, in some dam removal situations, neither of these options may be feasible because of hydrologic, geologic, and geochemical conditions that change in space



James E. Evans

Fig. 1. Dewatered impoundment showing the complexity of reservoir sediments. The IVEX Corporation dam on the Chagrin River in Ohio was constructed in 1842 and failed in 1994 after losing 86% of its storage capacity. Note the flood stratigraphy in the reservoir pool sediments and downstream movement (progradation) of the delta from upstream of the reservoir to the spillway. Within minutes of the failure, the rejuvenated channel incised 4.5 meters through the reservoir sediments and started widening.

and time (Figure 1). Previous studies have shown the progression of incision, channel widening, lateral channel migration, terracing, and new floodplain creation following dam removal [*Doyle et al.*, 2002] or dam failure [*Evans*, 2007]. The magnitude of sediment erosion and reworking vastly complicates attempts to stabilize (i.e., maintain in place) contaminated sediments.

Typically, more than 80% of the reservoir sediment is remobilized within several years after dam removal, depending on the frequency of floods [*Rathbun et al.*, 2005]. Sediment stabilization requires hydrologic forecasting for an environment that does not currently exist: the exhumed former reservoir and the newly restored river channel. The set of unknowns might be mitigated by (1) phased drawdown of the reservoir, exposure, and restoring vegetative ground cover on the reservoir sediments, (2) imposing a designed channel through the former reservoir, and/or (3) diking hot spots. Few dam removal studies document the success of these methods.

Historical Contamination Events

In addition, few studies have considered the effects of contaminant stratigraphy. In the proposed removal of Ballville Dam on the Sandusky River in Ohio, *Evans and Gottgens* [2007] found DDD/DDE pesticide residues at sediment levels corresponding to 1940–1980, the time when farmers in the drainage basin were using the pesticide DDT (Figure 2). In contrast, PAH concentrations were not consistent with historical use but were secondarily concentrated below the oxidized microzone in the sediment.

Peck et al. [2007] found elevated chromium, copper, and lead concentrations in the historical 1913 flood layer in the pool of the Munroe Falls Dam on the Cuyahoga River in Ohio. This was a 500-year flood event that destroyed industrial facilities upstream of the reservoir. If there are "hot layers" in the reservoir sediments, then the severity of downstream effects will depend on whether or not those layers are exhumed and remobilized after dam removal. Currently, no published case studies shed light on how likely this is to occur.

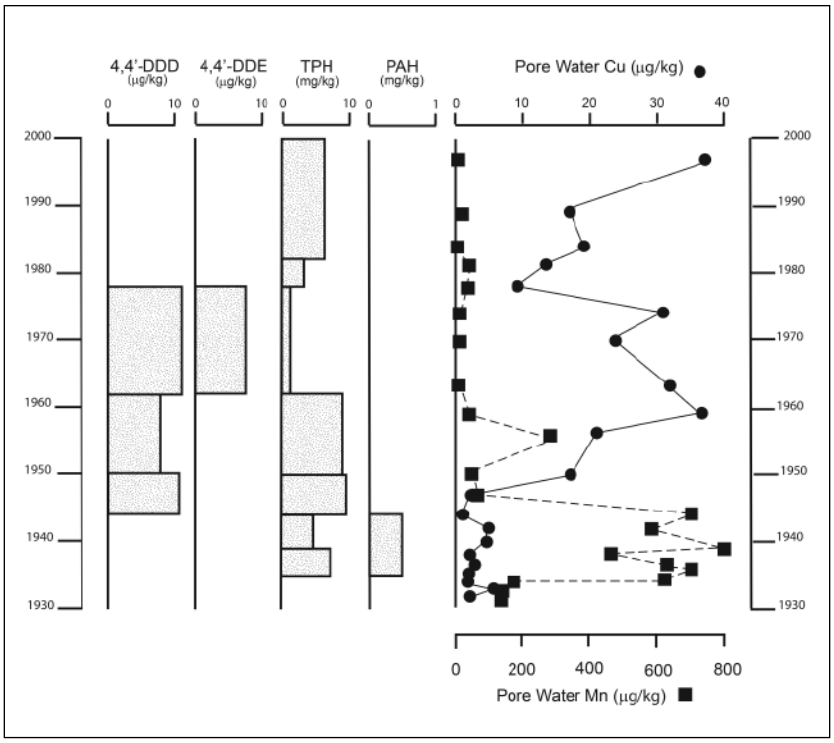
Research and Policy Needs

Dam removal managers need methods to anticipate contaminated sediment problems. *Rathbun et al.* [2005] have described a geographic information system (GIS)-based model called the Regional Impounded Sediment Quality Assessment (RISQA) model. RISQA uses historical data to identify upstream contaminant sources, hydrologic data to evaluate the quantity of contaminants that were transported to the reservoir, and the trapping efficiency of the dam to assess how likely contaminants are to be present. This type of model has great potential, and it needs to be tested and made more widely available.

If managers suspect that a dam may be impounding contaminated sediments, they then need follow-up studies to assess the sediment quality for each contami-

nant. However, translating reservoir sediment SQGs into downstream risks after dam removal will still be challenging. Managers lack information about the long-term success of phased drawdowns, capping, or hot spot isolation by diking in the former reservoir. And there are no studies about maintaining the stratigraphic isolation of hot layers.

Only certain states require sediment management plans prior to a dam removal [*Csiki and Rhoads*, 2010]. The lack of clarity about the acceptable magnitude and/or duration of contaminated sediment release from a former reservoir after dam removal may lead to litigation, exposing the organizations involved in dam removal and river restoration to liability risk.



Evans and Gottgens [2007]

Fig. 2. Chronostratigraphic plot of contaminant stratigraphy in a core from the Ballville Reservoir (Sandusky River, Ohio). The plot shows that DDT derivatives are found in a horizon corresponding to agricultural use in the drainage basin, whereas total petroleum hydrocarbons (TPH) and copper (Cu) vary throughout the core. Manganese (Mn) and polycyclic aromatic hydrocarbons (PAHs) are concentrated below the sediment redox zone.

A Growing Problem

Recent controversies surrounding several dam removals, such as the Sierra Club's lawsuit to halt the removal of Ballville Dam, indicate that contaminated sediment issues will continue to grow in importance in dam removal and river restoration projects. The scientific and policy communities must anticipate and act on the specific needs described above in order to ensure that the national progress continues in restoring rivers and improving water quality. Dam removals are transient hydrologic events with the potential of distributing contaminants downstream, yet at the present time there is little guidance about mitigating these effects.

Acknowledgments

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Field Data Management

Integrating Cyberscience and Geoscience

By Matty Mookerjee, Daniel Vieira, Marjorie A. Chan, Yolanda Gil, Terry L. Pavlis, Frank S. Spear, and Basil Tikoff

The geological sciences, maybe more than any other discipline, rely heavily on field studies to evaluate and interpret the natural world. It is increasingly important for field-based geoscientists to incorporate digital data management systems into their workflow to increase efficiency, data sharing, and collaboration and, ultimately, to answer larger scientific questions. Unfortunately, there is no one-size-fits-all data management system; field practices vary widely across disciplines, and individual researchers tend to customize these practices further.

However, with sufficient community involvement and communication, we can design a shared cyberinfrastructure to support most of the requirements of field-based research. A community cyberinfrastructure would preserve all field data and relevant metadata and make it publicly available while eliminating time-consuming and tedious postfieldwork digitization and data entry.

As part of the National Science Foundation's (NSF) EarthCube initiative (see http://earthcube.org/), NSF funded a Research Coordination Networks (RCN) project to facilitate dialogue between field-based geologists who currently lack an efficient digital workflow and computer scientists who specialize in databases linked by cybertechnologies. To this end, the project, called Earth-Centered Communication for Cyberinfrastructure (EC3; see http://bit.ly/sonoma_EC3), organized a field excursion in August 2014 to Yosemite National Park and Owens Valley that brought together representatives of these two groups.

During this field trip, the computer scientists learned about specific challenges related to field data collection, and the geoscientists were exposed to new technologies and infrastructure concepts that could allow them to work more efficiently and collaboratively. This trip facilitated lively group discussions about field technologies and their supporting cyberinfrastructure. Here we report to the broader community the results of these interactions to help build consensus and direct future funded projects.

Portable Electronic Tools

Much of the discussion focused on the benefits and downsides of the new wave of handheld devices and computers (including smartphones, tablets, rugged lap-

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tops, GPS, and digital compasses) for field data collection. Unfortunately, there is no current standard regarding the usage of these tools; each field geologist develops his or her own methodologies and conventions. This lack of standardization makes it challenging to share data and to design an effective and transferable cyberinfrastructure.

As an example of new field technology, participants from the British Geological Survey (BGS) presented its free software package, System for Integrating Geoscience Mapping (SIGMA), which enables scientists to collect, visualize, and map data on rugged tablet PCs. BGS's experiences in developing SIGMA provide lessons for our communities about developing field tools in tandem with cyberinfrastructure.

In particular, BGS developers work closely with geoscientists, often in the field, in an iterative process to develop an effective workflow for geologic mapping, sampling, and macroscopic data collection. SIGMA offers a wide variety of tools for sketching, stratigraphic logging, data entry, mapping structural contours, outcrop projection, and customizing one's workspaces. One downside is that SIGMA relies on the Environmental Systems Research Institute's (ESRI) proprietary ArcGIS software, which limits user access.

In addition to SIGMA, there are a number of applications for Windows, Android, and iOS mobile devices that assist geological data collection. A partial list includes

- University of Kansas implementation of ArcGIS
- University of Texas at El Paso's implementation of the open-source alternative QGIS
- ArcPad
- FieldMove
- Clino
- Rocklogger
- FieldNotesLT
- Lambert
- Geology Sample Collector
- Geocompass
- Strike and Dip
- GeoClino
- eGEO Compass
- GeoID

Unfortunately, all of these apps either have issues that limit their functionality or have customized interfaces that might not fit all workflows.

Fig. 1. During the 2014 field trip, many Earth-Centered Communication for Cyberinfrastructure (EC3) participants collected data and assessed the performance of data logging apps that use the compass-inclinometer sensors built into their phones or tablets.

One application that could ease paper-centric field geoscientists into a digital workflow with minimal disruption is Capturx. This product uses a digital pen that can capture handwritten text, numbers, and sketches from a specially designed field notebook. Once the data are uploaded from the pen, the user can then convert the handwritten notes and numbers to digital form with handwriting recognition software. This approach may work particularly well for researchers who are not yet comfortable with mobile devices and software. Other field trip participants also experimented with smartphone apps with voice recognition (like Evernote) to capture field notes, with significant success.

One common family of apps is point-based orientation data loggers that make use of the compass-inclinometer sensors built into many smartphones and tablets (Figure 1). During the field trip, many participants collected data using their phones (a variety of brands and models), and they assessed the quality of their measurements using several of these different apps. The results of this experiment were rather sobering. The range in their data for a single planar orientation was greater than 50° in the strike direction (a typical analog compass can measure the strike of a plane to within a few degrees). Much of the scatter originated from devices that lacked calibration modules, but other sources for error remain unknown.

The Ideal Field Data Collection System

To assess the priorities of the EC3 field trip participants for a mobile data collection system, we had them vote on suggestions that had been proposed in small breakout groups. The ranked list of recommendations in Figure 2 shows that our participants were very interested in an all-in-one type of device as long as they had confidence in the accuracy of the sensors built into that device.

This all-in-one system would alleviate the need to bring separate devices for GPS location measurements and collecting orientation data. Also, most people want an app to have the "feel" of a traditional field notebook. We interpret this result to mean that researchers do not want to be limited by the input format of a given app, for example, that they don't want to wade through a series of drop-down menus and that the freedom to customize the screen is important to them.

Several researchers emphasized the importance of sketches, not just as an important way of recording information but also because they play a cognitive role in thinking through scientific hypotheses like potential subsurface geometries and the temporal evolution of large-scale structures. The consensus was that the ability to easily draw interpretive lines directly on digital photographs while in the field is a real advancement.

Participants also felt strongly that any application that we developed should have underlying open-source code that community members could easily alter to fit their

Hardware	
10	**Visually pleasing screen**
3	**Lightweight and comfortable**
3	**Waterproof and ruggedized**
3	**Connects with other sensors**
2	**Quality camera**
2	**Reliable/accurate sensors**
1	**Long battery life**
Software: Tools	
16	**Accurate Measurements:** orientations, GPS, projections
11	**Feels like a field notebook** (starts with a blank page look)
11	**Maps**: pre-load, interactive layers, tools (pts/lines/polys)
10	**Sketches/photographs:** georeff, edit, annotate
8	**Voice recognition:** offline, map symbols
4	**3D/Augmented Reality**
3	**Select rock types from diagrams** (e.g., a ternary diagram)
3	**Operate offline**
3	**A companion Desktop app:** curate/customize mobile app
3	**Connectible to various other sensors**
2	**The ability to build a stratigraphic column**
2	**Easily customizable/modular use of screen real estate**
Software: data management	
9	**Easily syncable to database, backup to the cloud**
9	**The ability to access/download existing data**
4	**Data is easily exportable in useful, agnostic formats**
2	**Efficient workflow**
1	**The ability to share data easily**
Software: foundational	
11	**Open source ("community ownership") and free**
7	**Available on all platforms** (e.g., Mac, PC, tablet, phone)
6	**Open Geospatial Consortium (OGC)/standards compliant**
1	**Extensibility** (designed for future growth)

Fig. 2. EC3 participants voted on the characteristics they sought in a field data collection system. Measurement accuracy, a quality screen, an uncluttered interface that mimics a notebook, and open-source code were among the top priorities.

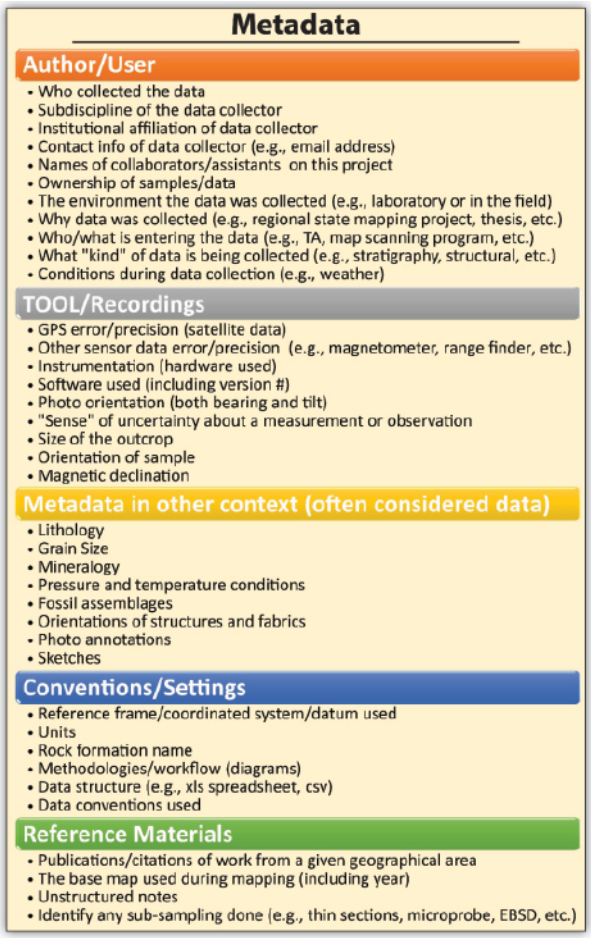

Fig. 3. EC3 participants listed different types of metadata that field geoscientists should capture as a standard part of their workflow and for inclusion in data repositories.

individual needs and that there should be a forum where researchers could share their modified code and modules.

Last, although the software in digital fieldwork is critical, there are some significant hardware challenges as well. Community members were concerned that the current generation of ruggedized devices has screens that are very difficult to see clearly in direct sunlight, especially if several people are trying to look at the same screen. These concerns have existed since the inception of digital mapping, and some devices address them much better than others.

Metadata

Management of metadata in a digital field workflow was another thought-provoking topic. The participants were asked to list all of the metadata that they felt were important to collect during fieldwork (Figure 3).

The initial part of this discussion focused on the very definition of "metadata" and how relative a term it truly is. For instance, in a study on the accuracy of location techniques, information such as the number of satellites and location error would be considered data, whereas in nearly all other studies they would be considered metadata.

Conversely, lithologies, orientations, fossil assemblages, and similar information would be considered primary data in most geological studies. However, in certain contexts, they would be considered metadata. Some computer scientists felt that it wasn't important to classify data as either "meta" or "primary," as long as community standards exist for what needs to be included.

A community-developed field app would help researchers capture data and metadata using community standards. For instance, a GPS device knows how many satellites it has used to determine its position, but most are not programmed to record that information, and those data are lost. Developing a field data collection app in tandem with community conversations about data and metadata standards may go a long way toward automating this process for many field-based researchers.

Some participants asserted that the most important function of metadata is to document a workflow and ensure the reproducibility of results. During a group exercise, participants split into groups and tried to describe a detailed workflow from a preselected article.

They gained an appreciation for the fact that method sections in scientific journal articles are rarely sufficient to fully reproduce a researcher's workflow. Some argued that full methodologies should be given their own unique digital object identifier, which subsequent publications could then cite. Metadata could play a vital role in documenting those methodologies and helping researchers assess the quality of a given data set.

A Meeting of the Minds

A unique aspect of the EC3 field trip was the bringing together of field-based geoscientists and computer scientists. By all accounts, this was a resounding success. Geoscientists were introduced to the range of technological possibilities, and the computer scientists gained a much deeper appreciation of the issues associated with field geological data. It was quite exciting and rewarding to see how the shared field experiences on the outcrop led to conversations that simply would not have occurred otherwise.

An important result of the EC3 field trip was the consensus on the need for developing an open-source field data collection application that adopts community standards on data and metadata. How that is accomplished and funded is beyond the scope of the EC3 project, but we hope that those who eventually develop this software will take our observations into consideration.

These are exciting times for geologic studies. We face a new era in which we can integrate field data into multidisciplinary geologic data systems, and a community-developed app will play a significant role in ushering it in.

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Looking Back to 2010: Birth of a New Vision for AGU

Before 2010, AGU was no stranger to strategic plans. But those plans pretty much "sat on a shelf," recalls former AGU president Carol Finn, a scientist at the U.S. Geological Survey in Denver, Colo. Shelved with them, Finn and other Union leaders sensed at the time, was AGU's chance to fully participate in, and maybe help steer, the waves of change rippling through the Earth and space sciences.

Today, AGU leaders are looking back over the half decade since a new type of strategic plan was adopted in September 2010. Their unease before then had led to a transition in leadership and a revitalized process in which AGU members and others from throughout the Earth and space science community were brought together to create a new vision for the future for AGU. The results: a living document that has guided AGU ever since and a wave of modernization and change within AGU that has remade the organization and continues to this day.

Lighting the Way

The plan articulated a mission and a vision for AGU supported by four major goals in the areas of science and society, scientific leadership and collaboration, organizational excellence, and talent pool (see http://sites.agu.org/leadership/strategic-plan/). It laid out dozens of objectives for the organization to pursue to fulfill those goals.

"The plan has been a 'north star' to guide our work and evaluate our success," said CEO and executive director Christine McEntee, who joined AGU the same year the strategic plan was adopted.

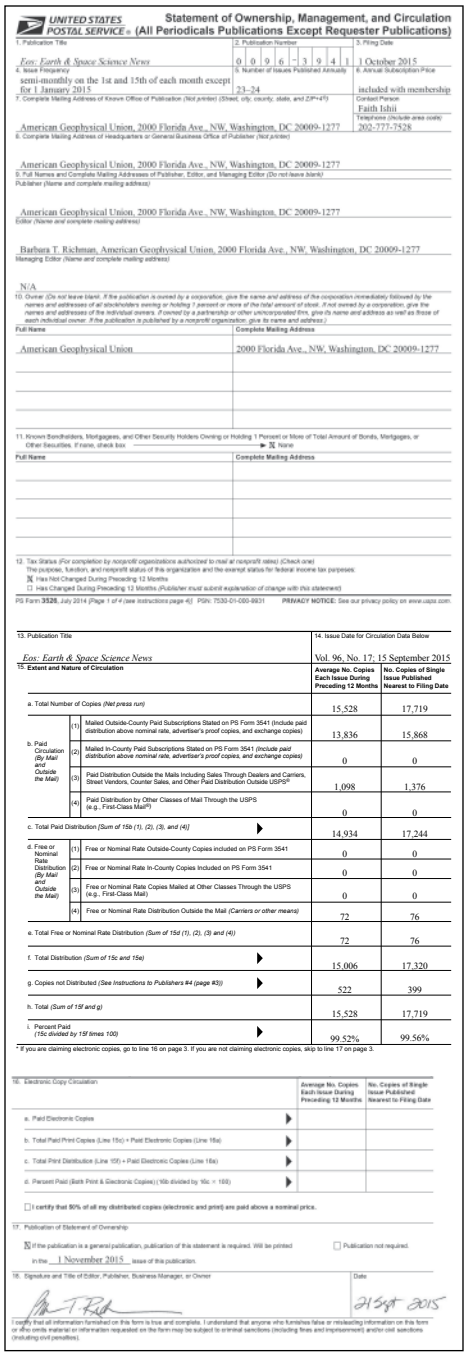
With the plan came a transformation of roles plus new forms of governance—including a Board of Directors and expansion of the Council to committee chairs and focus group leaders. The transition and new strategic plan opened doors for more members to be involved, specifically early-career scientists and students, in keeping with Carol Finn's aspiration to "always bring the future to the table." Those who contributed to building the strategic plan hoped that their contributions would allow AGU to live up to its promise as a

Under AGU's strategic plan, adopted in September 2010, four strategic goals support the central mission and vision of the organization. The plan's framers identified 8 priority objectives (bulleted) plus 20 other objectives not listed on this chart to usher AGU toward fulfilling its strategic goals.

leading organization in the Earth and space sciences.

"It was really more than just the plan," said Timothy Grove, a past president of AGU and professor at the Massachusetts Institute of Technology in Cambridge, Mass., who was president when the strategic plan was developed. "It was preparing the new leadership to operate strategically."

Inspiration for the plan came from "recognition that Earth and space science was evolving and that AGU…needed to evolve with it in order to stay relevant and impactful for the future," McEntee added.



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Evolve Here, Evolve There

AGU's evolution has taken many forms. By entering into a publication partnership with Wiley in 2012, the society took a major step to "increase the breadth, depth, reach, searchability, and discoverability of [AGU's] published content and to offer the scientific community the fastest time-to-publish in many of the fields our journals represent," McEntee said.

To build global cooperation and strengthen the geosciences, AGU forged partnerships with sister societies, such as the Society of Exploration Geophysicists, the Asia Oceania Geosciences Society, the European Geosciences Union, and the Japan Geoscience Union, said Michael McPhaden, another past president of AGU and a scientist at the National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory in Seattle, Wash.

AGU has also established programs to "bring geoscience to the community level," with the annual Science Policy Conference and the Thriving Earth Exchange, McPhaden noted. And, with programs like Sharing Science, it has worked to helped scientists improve their communication skills. Before 2010, "AGU operations were business as usual," said Finn. "Now, AGU regularly challenges itself to go beyond what we know, take calculated risks, evolve with the times. The result is a larger impact in Earth and space science and the communities beyond."

Ways to Grow

The strategic plan also calls for AGU to diversify its pool of members with regard to gender, ethnicity, race, age, and so on, across the geosciences and space sciences. As one of several ways to achieve that, the plan urges a more welcoming atmosphere for students and early-career scientists.

"Allowing student and early career scientists to serve as part of the AGU leadership is a huge commitment to this organization's progress," said Annie Tamalavage, a graduate student in oceanography at Texas A&M University in College Station who is one of three student members of the 61-member Council.

The current strategic plan doesn't offer answers for everything AGU will face in the years ahead. For instance, said McPhaden, AGU and sister organizations may need to focus on even earlier stages of budding scientists' lives to ultimately be able to meet goals of gender balance and ethnic diversity. That's because of insufficient education programs and opportunities at the lowest levels.

> "The plan has been a 'north star' to guide our work and evaluate our success."

Five Years New

Nonetheless, after 5 years, the plan remains a dependable source of inspiration and direction. It serves as "a critical framework for the leadership of AGU to be able to focus our attention on the most important things" under each of the four main pillars of the plan, said Margaret Leinen, AGU's current president and director of the Scripps Institution of Oceanography at the University of California, San Diego.

"While significant progress has been made, there is still much to be done," added Frank Krause, AGU's chief operating officer. Looking toward the future, he said, the Board has directed staff to "stay the course."

—**JoAnna Wendel,** Staff Writer

AGU Sections and Focus Groups Announce 2015 Awardees

Varner Receives 2015 Sulzman Award for Excellence in Education and Mentoring

Ruth K. Varner will receive the 2015 Sulzman Award for Excellence in Education and Mentoring at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is given for "significant contributions by a mid-career female scientist as a role model and mentor for the next generation of biogeoscientists."

Ruth K. Varner

Citation

Ruth Varner is acknowledged as a highly distinguished researcher in the field of biogeochemistry, where she leads projects spanning field observations through global modeling and devised novel techniques to measure methane. As an educator, she demonstrates long-term and substantial commitment to outreach and mentorship in a wide spectrum of community and academia. Letters in support of her nomination repeatedly acknowledge the centrality of education and outreach to her research program, with particular praise for the "cascade mentorship model" that she helped to develop. Dr. Varner has an impressive track record as a generous mentor, a distinguished researcher, and effective director of the Joan and James Leitzel Center for Mathematics, Science, and Engineering Education at the University of New Hampshire (UNH).

—Marilyn L. Fogel, *University of California, Merced*

Response

It is a great honor to receive the 2015 AGU Sulzman Award. Being recognized for my teaching and mentoring and placed alongside Dr. Sulzman is truly humbling.

During my career I have been able to do research in remote locations and work alongside students. Early on, I recognized that each student I worked with was a unique individual, that while one student could be very independent, another needed a more hands-on approach. For science to be accessible, we have to acknowledge and support these differences. This supportive research environment may require multiple mentors: graduate students, postdocs, staff, and faculty. My research group practices what we call "cascade mentoring." This approach came out of a partnership between our research group at UNH and Dr. Jill Bubier at Mount Holyoke College. Simply put, cascade mentoring succeeds because it recognizes that each student needs different things at different times in their development as a scientist. Most recently, I have used this approach in the Research Experience for Undergraduates program I run. The students in this program receive support from multiple mentors—faculty, postdoctoral scholars, international partners, and grad students. It takes a lot to succeed as a team. But the core component of this success is collaboration built on the ability to recognize the strengths of each individual member. I believe my career is not only about grants and publications but about training the next generation. Every day I marvel in how lucky I am to have the job I have.

The reason I have been able to understand what makes mentoring work is that I have been fortunate to have had supportive mentors during my career. From my beginnings as an undergraduate in Hartwick College's Geology Department and continuing through my graduate, postdoctoral, and faculty career at the University of New Hampshire, my mentors, Dr. Alexandra Moore, Dr. Dave Hutchison, Dr. Patrick Crill, Dr. Jill Bubier, Dr. Michael Keller, and Dr. Frank Birch, have supported and believed in me as a unique individual, each providing me with different kinds of support. I can't thank them enough. I have also had tremendous support from faculty, staff, and administrators here at UNH. They are too numerous to name individually, but I am grateful to them all. In their own way, each person has enabled me to combine my research and mentoring in a way that allows many students and teachers to have access to research opportunities. I am also grateful to the National Science Foundation for fostering the development of programs that include an appropriate level of support to let me implement mentoring activities.

Thank you, Dr. Scott Saleska, for writing my nomination letter, and Dr. Robert Harriss, Dr. Patrick Crill, and Dr. Maria Hunter, for writing letters in support of my nomination. Special thanks to the Biogeosciences section of AGU for giving me this wonderful honor.

—Ruth K. Varner, *University of New Hampshire, Durham*

Kapnick Receives 2015 Cryosphere Early Career Award

Sarah B. Kapnick will receive the 2015 Cryosphere Early Career Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is for "a significant contribution to cryospheric science and technology."

Sarah B. Kapnick

Citation

In a warming world, snow is a threatened resource, yet the dynamics of this threat are quite complicated, as evidenced by the 2015 record low snow along the west coast of the United States with simultaneous record high snowfall across the northeast coast. Scientifically, the diminishing snowpack has been well documented with numerous publications, but the authors generally split into two groups: those who specialize in snow processes (yet are not experts in atmospheric circulation and climate change) and those who specialize in atmospheric and/or climatic factors (yet are not experts in snow). Sarah's key contribution to cryospheric science and to society is her deep understanding of both fields. She bridges the gap rigorously in her publications and her communication to both scientists and the general public.

All of Sarah's work demonstrates a balanced approach to reconciling controversial problems dealing with snow and climate change. She presents clearly all sides of each issue (including the strengths and weaknesses of available observational data sets and models) and ties in the observations and model analysis with what we know physically and theoretically to move the science forward productively. In this way, all of her publications demonstrate that prior results (which at first glance may appear contradictory or ripe for climate skepticism) when taken together tell a coherent story—there will be "winners and losers" in snow accumulation in complex terrain because of combinations of orographic precipitation enhancement, warming temperatures (where areas with temperatures well below freezing will be much less sensitive than areas with temperature close to freezing), and atmospheric circulation shifts. Each of her publications provides guidance to where the community's efforts should be focused to answer pressing societal questions about changing snow and water resources.

In addition, Sarah takes considerable effort to communicate her work effectively to a much broader scientific and public audience than the snow hydrology community. Her ability to convey the widespread importance of her work is exemplified by Kapnick et al., published in *Nature Geoscience* (2014, doi:10.1038/ngeo2269). This paper, in addition to its scientific importance, presented cutting-edge snow hydrology research in a high-profile forum, which is very unusual for the discipline.

It is clear that Sarah not only is an accomplished scholar but is emerging as a key figure in identifying where the research needs to go and exhibiting substantial influence on the field of snow hydrology. She is clearly an emerging leader in the science of snow hydrology.

Previous AGU Cryosphere Early Career Award winners have become leaders in their field, and Sarah has clearly demonstrated herself to be very deserving of this recognition and to be counted among the ranks of emerging leaders in the cryospheric sciences

—Robin E. Bell, *Lamont-Doherty Earth Observatory, Columbia University, Palisades, N.Y.*

Response

Thank you, Robin, for your kind words. I am deeply honored to receive the Cryosphere Early Career Award and thank the National Snow and Ice Data Center for its generous monetary support of it. I am humbled to join the ranks of the previous accomplished awardees.

Throughout my career I have been fortunate to have many people who have stimulated my research and nurtured my creativity and must be thanked here. My Ph.D. adviser, Alex Hall, first suggested I look at California snowpack and has always given me advice and served as a sounding board for my ideas. My postdoctoral adviser, Thomas Delworth, helped me develop as a scientist and still emboldens me to take risks. Jessica Lundquist, Jeff Dozier, Gabriel Vecchi, Elena Shevliakova, George Philander, and Mimi Hughes have all provided support at important stages of my career. My collaborators have all helped take me in new directions. I would also like to thank my family, especially my husband and daughter, for their encouragement and for reminding me that there is a human aspect to my work.

Receiving this award serves as motivation to continue to uphold its legacy and push myself as I conduct my research. I hope I can live up to its significance.

—Sarah B. Kapnick, *Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration, Princeton, N.J.*

Ganti Receives 2015 Luna B. Leopold Young Scientist Award

Vamsi Ganti will receive the 2015 Luna B. Leopold Young Scientist Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes "a young scientist for making a significant and outstanding contribution that advances the field of Earth and planetary surface processes."

Vamsi Ganti

Citation

It is an honor to present Vamsi Ganti as the recipient of the AGU Luna B. Leopold Young Scientist Award for 2015. Vamsi has earned the Leopold Award for rigorous, creative work bridging stochastic and mechanistic approaches in geomorphology and hydrology. His starting point was stochastic hydrology, and his first major research contribution focused on so-called heavy-tail (power law) stochastic processes and what they mean for Earth surface behavior. Vamsi played a major role in understanding how power law distribution of transport step lengths in fractal landscapes leads to new fractional diffusion laws that change the way we think about erosional landscapes—the flux is no longer set by the local slope but instead is influenced by slopes elsewhere. This leads to replacement of ordinary integer-order derivatives in the diffusion equation with fractional-order derivatives and, in turn, to new solutions for the evolution of surface profiles with time. Moving to the opposite end of the source-sink system, Vamsi and colleagues showed that even though the physical geometry of stratigraphic recording (bed thickness) is dominated by "thin-tail" (exponential) statistics, the recording of time is thick tailed (power law), bounded by a time scale that is, on independent evidence, set by the avulsion frequency. He has also made important contributions on subjects ranging from controls on the shape of stratal boundaries to how backwater dynamics influences delta morphology.

Vamsi has already compiled a remarkable record of highly creative, quantitative research across a broad range of Earth surface dynamics. He has also been very deliberate—and not a little courageous—in leaving his comfort zone in mathematical statistics to develop a unique research style that is breaking down two of the major, and increasingly anachronistic, divides in the surface process world: between erosional and depositional systems and between stochastic and deterministic approaches. Although Vamsi's starting point on the road linking mathematics with the Earth's surface has been opposite to Luna Leopold's, Vamsi has ended up at a point that I think nicely reflects the spirit of Leopold's work. It is entirely fitting that he is the 2015 Leopold Award recipient.

—Chris Paola, *University of Minnesota, Twin Cities, Minneapolis*

Response

I thank the Earth and Planetary Surface Processes focus group (EPSP) and the people who nominated me for this award. I am deeply honored to receive this award. During my short career, I have been incredibly lucky to be part of interdisciplinary research environments at the St. Anthony Falls Laboratory (at a time when the National Center for Earth-surface Dynamics was in full flight), California Institute of Technology (Caltech), and now Imperial College, which shaped my scientific outlook. I share this award with my collaborators, colleagues, and mentors—both past and present—who have contributed in various ways to my development as a scientist. Thank you to Bill Dietrich, Gary Parker, Sanjeev Gupta, Woody Fischer, Vaughan Voller, Kyle Straub, Brandon McElroy, Colin Stark, Paola Passalacqua, Roman DiBiase, and Joel Scheingross for support and insightful discussions.

I would like to, however, single out three people to whom I owe much of my scientific growth and development. Efi Foufoula-Georgiou, my Ph.D. adviser, patiently guided me through my early years in science and provided me with unparalleled freedom to pursue a diverse set of research problems. Chris Paola introduced and inspired me to the fascinating worlds of laboratory experiments and the sedimentary record and encouraged me to blend stochastic and deterministic approaches in geomorphology and sedimentology. Mike Lamb advised my postdoctoral work, and his creativity and simplicity in approach and diversity of topics have been instrumental in fostering my scientific growth. It was under Mike's mentorship, I believe, when I made the transformation from being an engineer interested in Earth science problems to an Earth scientist who uses engineering and mathematical tools.

It is my pleasure to be a part of such an invigorating and vibrant community like EPSP. I look forward to many engaging and fun years of collaboration with my past and future colleagues. Thank you.

—Vamsi Ganti, *Imperial College London, London*

Anderson Receives 2015 G. K. Gilbert Award

Robert Anderson will receive the 2015 G. K. Gilbert Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes "a scientist who has either made a single significant advance or sustained significant contributions to the field of Earth and planetary surface processes, and who has in addition promoted an environment of unselfish cooperation in research and the inclusion of young scientists into the field."

Robert S. Anderson

Citation

The diversity of opportunity that greets geomorphologists today is stunning: It ranges from Google Earth's view of the entire planet to our ability to measure rocks flexing beneath breaking waves. Today, our challenge is less in making observations; rather, it's deciding which observations can provide critical insights on how, when, and why diverse surface processes sculpt Earth's surface. Few geomorphologists have been as incisive in choosing the key observations needed to quantify a problem, as creative in their use of technology, as diverse in the range of geomorphic environments that they have studied, or as productive in developing new, quantified theories of landscape evolution as this year's G. K. Gilbert Award winner, Bob Anderson.

For nearly 30 years, Bob has shown us how to combine a rich understanding of geomorphic processes with strong skills in mathematical and physical analysis in order to attain fundamental new insights on landscapes. He has used this combination to develop novel theories explaining processes and landforms at scales that span from eolian sand grain impacts to mountain ranges. Bob's ability to move seamlessly from the geophysical aspects of crustal dynamics to the mechanics of frost

cracking to new applications of cosmogenic nuclides has repeatedly given us remarkable insights on how the Earth works.

During his years at Santa Cruz and Colorado, Bob has mentored a noteworthy group of younger geomorphologists who are now advancing our field in new directions. In nearly all of their publications, Bob's mentorship and intellectual "fingerprints" are clearly visible. Bob's freely available pedagogical gem "The Little Book of Geomorphology: Exercising the Principle of Conservation" typifies his rigorous thinking, his perennial enthusiasm and curiosity, and his scholarly generosity.

For his remarkable, provocative, and diverse contributions to our field, Bob Anderson is distinctly deserving of the 2015 G. K. Gilbert Award.

—Douglas Burbank, *University of California, Santa Barbara*

Response

I am deeply honored to receive this award, and I thank Doug for this flattering citation. This award reflects the inspiration of the geoscientists by whom I was lucky enough to be taught, the quality of the colleagues with whom I have worked over the last 30 years, and, perhaps most importantly, the hard work, the fun, and the friendship of the students with whom I have collaborated.

Let me feature one deserving more credit than most, my wife and colleague, Suzanne. I thank her for her support and inspiration in all facets of our lives. That little book Doug refers to was followed by the bigger book that we cowrote and that so dominated the early lives of our kids.

Having written as my master's thesis a biography of Clarence Dutton, who worked with J. W. Powell and G. K. Gilbert to introduce the world to western North American landscapes, I have been acutely aware of Gilbert's work throughout my career. His research, his choice of problems to address, and the organized manner in which he went about it are mirrored in the research of the prior Gilbert awardees and have set the tone of our community's growth in the last few decades. Being a part of this legacy has been one of the chief joys of my research life.

But there is still much to do. Although I was lucky to catch the waves of numerical landscape modeling and application of cosmogenic radionuclides, it is clear that new technologies like autonomous vehicles, lidar, structure from motion, and miniaturization of environmental sensors will further push surface process research into new frontiers and perhaps new worlds. But who knows what new tools will arise on the longer time frame? That's why we play the game and what makes it so much fun.

—Robert S. Anderson, *University of Colorado Boulder, Boulder*

Pritchard Receives 2015 Geodesy Section Award

Matthew E. Pritchard will receive the 2015 Geodesy Section Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is given in recognition of major advances in geodesy.

Matthew E. Pritchard

Citation

Matt Pritchard is presented with the 2015 Geodesy Section Award for his transcendent work in volcano and earthquake science and selfless support of the community. Matt was among the first to use interferometric synthetic aperture radar (InSAR) to examine entire volcanic arcs instead of individual volcanoes. This broader approach led to the recognition of a number of deforming volcanoes that were previously unknown, stimulating several follow-on studies, and has elucidated linkages between arc volcanism and large earthquakes.

Matt's efforts also proved the viability of broad monitoring of volcanic arcs from space, establishing the basis for international efforts to develop a global volcano monitoring strategy.

In addition to volcanology, Matt has lent his considerable expertise to seismology, tectonics, planetary geology, glaciology, and climate change. Although InSAR remains Matt's primary observational tool, he has shown exceptional vision by combining InSAR with other remote sensing, seismic, and geologic data to attain a more synergistic view of volcanic and earthquake processes.

Although Matt's research alone is ample justification for the Geodesy Section Award, his record is impressively supported by a strong commitment to the community through his teaching excellence and service on numerous committees and initiatives, including WInSAR (Western North America Interferometric Synthetic Aperture Radar Consortium), UNAVCO (University NAVSTAR Consortium), NISAR (NASA-ISRO SAR Mission), GeoPRISMS (Geodynamic Processes at Rifting and Subducting Margins), the Global Volcano Model, and the CEOS (Committee on Earth Observation Satellites) Volcano Pilot. In each of these areas Matt has promoted data sharing and collaboration as means to maximize science return. Matt is also an exceptional colleague, generous with his time and expertise, providing assistance to international scientists and volcano observatories in the use of InSAR to respond to volcano and earthquake crises.

The field of geodesy is better for having Matt as a colleague. Not only has his research moved several fields forward, Matt has also advanced the community through his unselfish service. We are pleased that Matt Pritchard's dedication and research excellence are being recognized with the 2015 Geodesy Section Award.

—Michael P. Poland, *Cascades Volcano Observatory, U.S. Geological Survey, Vancouver, Wash.; and* **Paul R. Lundgren**, *Jet Propulsion Laboratory, Pasadena, Calif.*

Response

I am humbled and honored by the kind citation. Although I find that the award process is inadequate—there are so many deserving who are overlooked—I appreciate everyone who helped with my nomination.

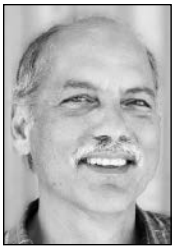
This is an exciting time in geodesy. There is an explosion of new techniques and satellite missions that allow us to tackle important scientific and societal problems, but I only became aware of this field once I arrived in graduate school. On the basis of this admittedly limited evidence, I suggest that we have to work harder as a community to communicate the opportunities to younger students—in particular at the middle and high school levels. My interest in geology and planetary science was nurtured during those grades by numerous volunteers who aided and judged science fair and 4-H projects, gave public lectures, and answered my questions about careers in the field. In particular, I want to thank Robert H. Brown of the University of Arizona—he answered many questions from a high school student thousands of miles away that resulted in a Westinghouse Science Talent Search project and set me on the path to graduate school at the California Institute of Technology (Caltech). Whenever I feel too busy to respond to help random students, I try to remember his example.

One great perk of being a geodesist is the supportive community of scientists. I thank my students, postdocs, mentors, advisers, and collaborators for teaching me so many interesting things and making this such a fun career. Of course, there are always bumps in the road, and I owe a lot to my wife and collaborator on projects big and small, who makes the journey worth it, Rowena Lohman, the 2013 recipient of this award.

—Matthew E. Pritchard, *Cornell University, Ithaca, N.Y.*

Meertens Receives 2015 Ivan I. Mueller Award for Distinguished Service and Leadership

Charles Meertens will receive the 2015 Ivan I. Mueller Award for Distinguished Service and Leadership at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes "major achievements in service and/or leadership to the geodesy community."



Charles Meertens

Citation

For the last 3 decades, Chuck Meertens has served the geodesy community through his work and leadership in UNAVCO, a consortium of research institutions (universities) that assists investigators with space geodetic (using Global Navigation Satellite Systems (GNSS) and other techniques for Earth science research).

Chuck is one of a handful of leaders who have helped lead the geodesy community into an exciting new era that has employed technological advances to open vast new areas of research in the Earth sciences. He was at UNAVCO in its infancy, and he helped build up this important community institution from the ground up. It's fair to say that Chuck has contributed, in one way or another, to virtually every area of geodesy, from the development of strain and tiltmeters to gravity observations, GPS field data collection, instrumentation development, data analysis, archiving, and education and outreach. Indeed, it is hard to find people in the field who Chuck has not helped—he is involved in field campaigns, data analysis research, and development of new instrumentation, and he freely gives his time to a variety of professional organizations and executive boards.

Chuck has helped hundreds of scientists over the years, most often very anonymously and with little credit to himself. Chuck is always a team player and willing to jump into any challenge to find a solution that is beneficial to the community. And to top it off, he's just a delightful guy—full of energy, enthusiasm, unshakeable optimism, and generosity. It would be difficult to imagine anyone more deserving of this award.

—R. Steven Nerem, *University of Colorado Boulder, Boulder*

Response

I would like to thank the AGU Geodesy section and those involved in this nomination for the great honor of being selected for this year's Ivan I. Mueller Award. Art Sylvester, at the University of California, Santa Barbara, first introduced me to the fascinating notion of using geodetic techniques to directly measure active geologic processes. Chris Harrison and Judah Levine, at the University of Colorado Boulder, taught me the beauty in making sensitive geodetic instruments capable of recording the smallest motions of the Earth.

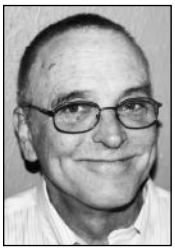
Sometimes opportunity intersects with interests, and I was fortunate to ride with the first wave of scientists using new "portable" GPS instruments to study what has proved to be nearly boundless sets of geophysical problems. It has been very rewarding to contribute to what my International GNSS Service colleague Chris Rizos calls the "beginnings of a geodetic renaissance." I owe a debt of gratitude to Stick Ware and Chris Rocken for providing me the chance to explore GPS technology at UNAVCO and to Bob Smith at the University of Utah for the opportunity to team up to make the first GPS measurements at Yellowstone.

Ultimately, my interests and activities tended toward understanding and providing infrastructure needed to support a broad user community. In this pursuit I have been privileged to work with a talented and creative group of technologists, scientists, and educators who desire to make the best geodetic measurements possible, tackle tough scientific and societal problems, and share data and knowledge. Ivan Mueller embodies these collective goals, and I am deeply appreciative of receiving this award that honors him. I am also humbled, as this recognition extends to my many colleagues who share in this vision of infrastructure and community for collaboration. I am grateful to Meghan Miller for enabling this vision, to my UNAVCO colleagues who make it happen, and to my friends and family for their unwavering support and inspiration.

—Charles Meertens, *UNAVCO, Boulder, Colo.*

Jackson Receives 2015 William Gilbert Award

Michael Jackson will receive the 2015 William Gilbert Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes outstanding and unselfish work in magnetism of Earth materials and of the Earth and planets.



Michael Jackson

Citation

With great pleasure we present the 2015 William Gilbert awardee, Michael Jackson, recognizing his fundamental contributions and pioneering applications in rock and paleomagnetism and his unselfish service to the geomagnetism and paleomagnetism community. Many know Mike as facility manager of the Institute for Rock Magnetism (IRM), and many have experienced firsthand his generosity and help. It was once said that Mike is the face of the IRM, but he isn't just another pretty face. Truly, he is a world-class rock magnetist known for drilling down into fundamental rock magnetism to solve paleomagnetic problems.

Two examples highlight his many research accomplishments. Mike discovered that nanophase magnetite caused by orogenic fluids was responsible for large-scale remagnetization of Paleozoic limestones in North America. Using hysteresis and low-temperature magnetometry, he identified which limestones were accurate paleomagnetic recorders and which were remagnetized long after deposition. The second is an elegant application of anisotropy of magnetic remanence (AMR) in sedimentary rocks that led to his discovery that inclination shallowing due to compaction can be corrected by determining the AMR tensor. As a supporting letter states, "This much-cited seminal work paved the way and provided rigorous ground truth to other methods for retrieving accurate paleolatitudes from sedimentary rocks, thereby further improving paleogeographic reconstructions."

Mike's impact on our field goes beyond research accomplishments. As IRM facility manager for over 20 years, Mike plays a pivotal role in its intellectual vision and in making it an acclaimed international center for research and education in rock magnetism. He has provided support through mentoring and training to over 200 visiting scientists. As his style, he helps each visitor make the most of their IRM visit, blending a mix of patience, sage advice, personal assistance, and genuine interest in their work. In many ways, Mike personifies the AGU motto of "unselfish cooperation."

—Bruce M. Moskowitz *and* **Subir K. Banerjee**, *Institute for Rock Magnetism, Department of Earth Sciences, University of Minnesota, Twin Cities, Minneapolis*

Response

Thank you, Bruce and Subir and all my friends and colleagues. It is, of course, gratifying to receive this award, and I'm truly honored to be in the company of the previous recipients. It's also a bit disconcerting because there are many others whom I consider to be more qualified than I am for this distinction. But I interpret this award as a recognition not just of me individually but also of the Institute for Rock Magnetism and the team there of which I am a part, and in this spirit I gratefully accept it.

I feel very fortunate to belong to the Geomagnetism and Paleomagnetism section in general and to the IRM in particular. We share a truly fascinating field of study, building on the work of Gilbert, Gauss, Néel, and so many others, combining the mesmerizing physics of magnetism with an endless variety of geological and extraterrestrial processes. And the Geomagnetism and Paleomagnetism section is a real research community. For the most part our members are happily independent and self-reliant, running individual labs and pursuing independent lines of investigation, yet we also value and support collective efforts such as the MagIC database and the IRM instrumentation facility, which serve as community resources to the benefit of all.

I owe a great debt of thanks to many who have inspired me, mentored me, collaborated with me, and improved my work through constructive criticism, and I regret that space limits the number whom I can mention explicitly. In Ann Arbor, Rob Van der Voo and Henry Pollack introduced me to geophysical research and more broadly to the processes of scientific thought and inquiry. In Minneapolis, Subir Banerjee deserves enormous credit for his wisdom and vision in establishing the IRM, the collegial environment in which I've been privileged to interact with him and with a large number of eminent visiting scientists, as well as with a host of exceptional resident scholars, including Bruce Moskowitz, Horst Worm, Jim Marvin, Peat Solheid, Julie Bowles, Josh Feinberg, Dario Bilardello, and Brian Carter-Stiglitz. I thank them all, I thank you all, and I hope to see you at the IRM.

—Michael Jackson, *Institute for Rock Magnetism, University of Minnesota, Twin Cities, Minneapolis*

Entekhabi Receives 2015 Hydrologic Sciences Award

Dara Entekhabi will receive the 2015 Hydrologic Sciences Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is for outstanding contributions to the science of hydrology.

Dara Entekhabi

Citation

It is my great pleasure to announce Dara Entekhabi as the recipient of the 2015 Hydrologic Sciences Award. This recognition shows the respect and admiration that my colleagues and I have for Dara's contributions to the hydrology community. Dara's professional activities span an impressive range, from theoretical insights, through innovative data analyses, to the management of an important satellite mission.

Dara's scientific work is based on his appreciation of the key role of the land surface in hydrology and meteorology. Dara's contribution has been to clarify the complex processes and feedbacks that take place at the land-atmosphere boundary. His activities have spanned the disciplines of hydrology, meteorology, and remote sensing, as reflected in the recognition he has received from the associated professional societies: AGU, the American Meteorological Society, and the Institute of Electrical and Electronics Engineers.

Dara's appreciation of the importance of the land-atmosphere boundary led him to seek more accurate observations of soil moisture and evapotranspiration, not only at isolated times and locations but in a comprehensive way, through remote sensing, that reveals the variability of the relevant processes. Dara was an early leader in applying the methods of data assimilation to this task, using land surface models to constrain an otherwise ill-posed inverse problem. Dara has also made important contributions in climate science that include his work on continental-scale precipitation recycling and on the connections between snow anomalies, boundary layer evolution, and Northern Hemisphere atmospheric circulation.

The culmination of this impressive set of contributions has been Dara's leadership in the SMAP (Soil Moisture Active Passive) satellite mission. I think it is fair to say that this mission would not have taken place without Dara's unceasing efforts and organizational skills. Dara's tireless work and substantial accomplishments with SMAP over the last several years really deserve to be acknowledged with a collective "thank you" from the hydrologic community.

—Dennis B. McLaughlin, *Massachusetts Institute of Technology, Cambridge*

Response

I thank my colleagues for their kind words and the recognition. It is a collective gratitude since the cited efforts all result from collaboration with colleagues and students. I stand as a proxy for them.

I was fortunate to enter this field at a revolutionary time. Hydrology as a geoscience marked a milestone the year I started as a young faculty. The book *Challenges and Opportunities in the Hydrologic Sciences* was published, and it was inspiring. It was the culmination of years of deliberations by a National Research Council committee chaired by Pete Eagleson. As an apprentice and student of Pete, I was fortunate to witness the process and absorb its vision.

Since then and together with extraordinary students and colleagues, we have feasted on the opportunities that the revitalized field laid in front of us. The shifted focus on hydrology as a geoscience meant exploring at the interface of meteorology and hydrology. The land surface no longer represented a marking boundary for the disciplines. Walls had come down, and there was much to explore and learn.

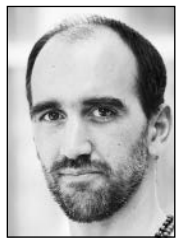
As recognized in the Blue-Book chapter on data (National Research Council, *Opportunities in the Hydrologic Sciences,* 1991), in the hydrologic sciences like other sciences, significant advances often result from new measurements that can inspire rethinking of paradigms. In another chance encounter, I found myself an apprentice again. This time it was Eni Njoku from the Jet Propulsion Laboratory who introduced me to remote sensing. I have had the extraordinary opportunity of working on hydrology mission concepts and flight projects. These are large team efforts, and I am grateful for the chance to work alongside these teams.

I have a long list of students and colleagues to thank. I am sad that I cannot list them all. I am glad that the list is that long.

—Dara Entekhabi, *Massachusetts Institute of Technology, Cambridge*

Gleeson Receives 2015 Early Career Hydrologic Science Award

Thomas Gleeson will receive the 2015 Early Career Hydrologic Science Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is for significant early career contributions to hydrologic science.



Thomas Gleeson

Citation

Tom Gleeson is one of the rising stars of international hydrology. Tom's specific discipline is hydrogeology, which traditionally has demonstrated a tendency toward localism and detailed and complex modeling. Tom has embraced a more holistic approach, and the fast-increasing impact of his work demonstrates the usefulness of a broad perspective. He has tackled key issues in hydrogeology—groundwater depletion, the nature of permeability—and made substantial progress on a global scale.

A major issue facing human society is sustainable water supply for our increasing population. In that context, hydrologic science must attempt to support informed decision making. Tom led a 2012 *Nature* paper, "Water balance of global aquifers revealed by groundwater footprint," that revealed that about 2 billion people worldwide live in areas where groundwater resources are stressed. Not content to state the problem, Tom then organized and wrote a series of papers that assessed possible solutions: "Towards sustainable groundwater use: Setting long-term goals, backcasting, and managing adaptively" (*Groundwater,* 2012, doi:10.1111/j.1745-6584.2011.00825.x), "Regional strategies for the accelerating global problem of groundwater depletion" (*Nature Geoscience,* 2012, doi:10.1038/ngeo1617), and "Vulnerability of coastal aquifers to groundwater use and climate change" (*Nature Climate Change,* 2012, doi:10.1038/nclimate1413). In each case, Tom worked with distinguished senior hydrologists as coauthors, so that to some extent these papers serve to represent community opinion.

Tom has taken a similarly global approach to characterization of permeability, the key hydrogeologic parameter that governs groundwater flow, advective heat and solute transport, and the generation of elevated fluid pressures. The variability of permeability is such that it is often considered to defy systematic characterization. Tom's work has nonetheless revealed some order in globally compiled data; his 2011 *Geophysical Research Letters* paper "Mapping permeability over the surface of the Earth" (doi:10.1029/2010GL045565) is another visionary effort to synthesize and extend available data to the global scale.

On the basis of these and other precocious accomplishments—impossible to adequately describe within the space constraints—Tom Gleeson is a most worthy recipient of the 2015 Early Career Hydrologic Science Award.

—Steven Ingebritsen, *U.S. Geological Survey, Menlo Park, Calif.*

Response

This award is a huge honor that is both humbling and inspiring. So thank you, Steven and everyone who has supported me along my path.

I love thinking about large-scale, pressing problems with engaging, multidisciplinary colleagues. The seeds of this path were planted during my undergrad in an interdisciplinary department that examines Earth systems holistically; I am still motivated by questions like "How, when, why, and where does groundwater interact with other parts of the earth system?" One particularly important nugget of advice I received at that time was "always hang out with the best people you can; they will inevitably rub off."

Following this advice, I have found a seemingly endless treasure trove of smart, passionate, and kind colleagues, collaborators, mentors, and students. I am thankful to my supervisors, Stephen Johnston, Laurent Godin, Kent Novakowski, and Leslie Smith, who individually have made me a better scientist and person. And I am thankful to interact with many amazing colleagues who continue to propel my research of groundwater systems and sustainability. And above all, I am grateful for the best people that I get to

hang out with: my partner, Claire, parents, family, and friends, who definitely make me a better person and always support me, even while sometimes lovingly asking, "Really, you want to research that?"

Sometime during my Ph.D. I became inspired by another question: "How can a hydrogeologist meaningfully contribute to sustainability in a changing world?" I find it very rich and interesting to simultaneously look at the world as a scientist interested in the Earth system and an engineer interested in sustainable water resources. It is an exciting time to study groundwater since it is being studied at larger scales and using tools and approaches from more fields than ever before. Once again, thank you!

—Thomas Gleeson, *University of Victoria, Victoria, B.C., Canada*

Visit http://eos.org/agu-news to read more announcements of AGU section and focus group awards.

Chang and Zhang Receive the 2015 Mineral and Rock Physics Graduate Research Award

Yun-Yuan Chang and Dongzhou Zhang will receive the 2015 Mineral and Rock Physics Graduate Research Award, given annually to one or more promising young scientists for outstanding contributions achieved during their Ph.D. research. Recipients of this award are engaged in experimental and/or theoretical studies of Earth and planetary materials with the purpose of unraveling the physics and chemistry that govern their origin and physical properties.

Yun-Yuan Chang

Yun-Yuan Chang received her B.S. in aeronautics and astronautics from National Cheng Kung University (Taiwan) in 2002 and a M.Sc. in material science and engineering from Stanford University in 2008. She received her Ph.D. in mineral physics under the supervision of Steven Jacobsen and Craig Bina at Northwestern University in Evanston, Ill. Her research interests include the influence of defects on properties of minerals and Earth's deep water cycle.

Dongzhou Zhang

Dongzhou Zhang received his B.S. in physics from Peking University, Beijing, China, in 2008. He completed his Ph.D. in geophysics under the supervision of Jennifer Jackson at California Institute of Technology, Pasadena, in 2014. He is currently the beamline scientist of the Partnership for eXtreme Xtallography program affiliated with the University of Hawai'i at Mānoa and located at the GeoSoilEnviroCARS at Argonne National Laboratory. His research interests include physics and chemistry of the planetary interiors, high-pressure physics, and synchrotron-based X-ray techniques.

Brantut Receives 2015 Mineral and Rock Physics Early Career Award

Nicolas Brantut will receive the 2015 Mineral and Rock Physics Early Career Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is for promising young scientists in recognition of outstanding contributions achieved during their Ph.D. research.

Nicolas Brantut

Citation

The Mineral and Rock Physics focus group of AGU is pleased to honor Dr. Nicolas Brantut as the recipient of the 2015 Mineral and Rock Physics Early Career Award. Nicolas earned his master's and Ph.D. from the École Normale Supérieure in Paris in 2010, working with Professor Alexandre Schubnel, Professor Yves Guéguen, and Professor Toshihiko Shimamoto (at Kyoto University). Following his Ph.D., Nicolas moved to University College London (UCL), where he worked as a postdoctoral researcher with Professor Philip Meredith. Nicolas's research has ranged from experimental studies to complementary theoretical advances. Over his short career, he has made several important contributions to our understanding of fracture and friction and has shown in elegant ways how mineral chemistry and physics interact during coseismic deformation. At the present time Nicolas is completing a prestigious Natural Environment Research Council research fellowship, after which he will accept a faculty appointment at UCL. Congratulations, Nicolas!

—Philip A. Skemer, *Washington University in Saint Louis, Saint Louis, Mo.*

Response

I am deeply honored to receive this year's Mineral and Rock Physics Early Career Award. I would like to thank my Ph.D. adviser, Alexandre Schubnel, for setting me up on a great research topic, his invaluable insight, and his patience with me. I am also grateful to Yves Guéguen, who made me discover rock physics during his fantastic lectures at École Normale Supérieure (ENS), and to Toshi Shimamoto for his support during my visits in his laboratory in Kyoto and then Hiroshima. I have had the immense luck to study and then work at ENS in Paris, where I received a high-level, free education and found an incomparable research environment and a friendly atmosphere.

My research is multidisciplinary and collaborative, and in the past few years I have been involved in a number of proj ects in the United States, France, and the United Kingdom. I would like to acknowledge the strong support I have received from everyone I have worked (and continue to work) with. In particular, I am forever thankful to Jim Rice, who welcomed me in his group at a critical time after my Ph.D. and from whom I learned a lot despite the short time allowed. A special mention goes to Phil Meredith, who gave me total freedom during my postdoc with him and who continues to support me in a variety of ways (including understanding the arcane details of the British culture and research system).

This Early Career Award is a mark of trust and an encouragement for future work, and it gives me further motivation to do the best possible work in the coming years.

—Nicolas Brantut, *University College London, London, U.K.*

Curbelo and Ghanbarian-Alavijeh Receive the 2015 Donald L. Turcotte Award

Jezabel Curbelo and Behzad Ghanbarian-Alavijeh will receive the 2015 Donald L. Turcotte Award, given annually to recent Ph.D. recipients for outstanding dissertation research that contributes directly to the field of nonlinear geophysics.

Jezabel Curbelo

Jezabel received her B.S. in mathematics from Universidad de la Laguna in 2009 and a M.Sc. in mathematics and applications from Universidad Autónoma de Madrid (UAM) in 2010. She received a Ph.D. in mathematics from the Universidad Autónoma de Madrid in 2014. Her Ph.D. work was done under the supervision of Ana M. Mancho at the Instituto de Ciencias Matemáticas, a joint research initiative of Consejo Superior de Investigaciones Científicas and three universities in Madrid (UAM, Universidad Complutense de Madrid, Universidad Carlos III de Madrid). Her research interests include convection, instabilities and bifurcations, dynamical systems, and numerical methods for problems in geophysical fluid dynamics.

Behzad Ghanbarian-Alavijeh

Behzad Ghanbarian-Alavijeh received his B.S. in water engineering from Isfahan University of Technology in 2005 and a M.Sc. in irrigation and drainage from the University of Tehran in 2007. He received his Ph.D. in environmental sciences from Wright State University under the supervision of Allen Hunt in 2014. He is currently working as a postdoctoral research fellow in the Petroleum and Geosystems Engineering Department, University of Texas at Austin. His research interests include analytical and numerical modeling of fluid flow and solute transport in disordered porous media.

Lakhina Receives 2015 Space Weather and Nonlinear Waves and Processes Prize

Gurbax Lakhina will receive the Space Weather and Nonlinear Waves and Processes Prize at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes significant contributions in the field of space weather or nonlinear waves and processes.

Gurbax Lakhina

Citation

The AGU Nonlinear Geophysics focus group and Space Physics and Aeronomy section have awarded the Space Weather and Nonlinear Waves and Processes Prize to Gurbax S. Lakhina, the former director of the Indian Institute of Geomagnetism, Navi Mumbai, India.

Gurbax Lakhina has carried out cutting-edge research on coherent chorus wave interaction with radiation belt electrons, nonlinear boundary layer waves in space plasmas, microstructure of the interplanetary medium, and space weather.

Lakhina's major contribution to radiation belt physics include development of a theory for a nonlinear coherent cyclotron interaction between electromagnetic whistler mode chorus and energetic electrons, showing that chorus has circularly magnetic polarization at all angles of propagation relative to the ambient magnetic field and that the waves change from a highly coherent nature at the source location into quasi-coherent waves with propagation. His work on pitch angle transport with coherent waves will impact the fields of space plasma physics, laboratory fusion, and astrophysics.

Gurbax Lakhina has made a seminal contribution to the generation mechanism for electrostatic solitary waves (ESWs) in terms of ion- and electron-acoustic solitons and double layers. Gurbax has made fundamental contributions in identifying the interplanetary causes of intense and superintense magnetic storms, including the classic work on the 1859 Carrington superstorm and on clarifying the physics of the mirror mode structures occurring in planetary magnetosheaths and the magnetic decreases that occur in interplanetary space.

Gurbax Lakhina is an eminent space plasma physicist. He has promoted space science both within India and internationally with other developing countries. He has acted as a mentor to many young researchers in India and other third-world countries, inspiring them both by his instruction and by his example. He is truly worthy of the 2015 AGU Space Weather and Nonlinear Waves and Processes Prize.

—Abraham C.-L. Chian, *National Institute of Space Research, São José dos Campos, Brazil, and University of Adelaide, Adelaide, Australia*

Response

I am delighted and greatly honored to receive 2015 AGU Space Weather and Nonlinear Waves and Processes Prize. I would like to thank AGU, the Nonlinear Geophysics focus group and Space Physics and Aeronomy section award committee, and my nominators/supporters for this exceptional honor. I particularly thank Professor Abraham Chian for nominating me. Abe is a brilliant nonlinear plasma wave and chaos researcher who has given the field many new insightful concepts.

I thankfully acknowledge the contribution of Bruce Tsurutani (Jet Propulsion Laboratory (JPL)/California Institute of Technology), Jolene Pickett (University of Iowa), and Olga Verkhoglyadova (JPL) toward my research on chorus and ESWs. Without their important experimental inputs, it would not have been possible to develop the theory for resonant

coherent chorus interaction with energetic electrons, a new concept for energetic particle scattering with far-reaching applications, further than just space plasma physics.

I would like to thank my group members at the Indian Institute of Geomagnetism, Navi Mumbai, R. V. Reddy, Satyavir Singh, Sukti Ghosh, and Amar Kakad, along with Frank Verheest (Ghent University, Belgium), Ramesh Bharuthram (University of Western Cape, South Africa), and Shimul Maharaj (South African National Space Agency) for their excellent long-term collaboration toward developing theoretical models for the observed electrostatic solitary waves in the Earth's magnetosphere by Cluster and also their application to dusty plasmas.

I am indebted to Bimla Buti (India); my Ph.D. supervisor, Karl Schindler (Germany); and all my collaborators and thank them for contributing toward my scientific and personal growth.

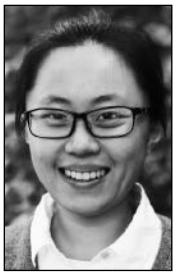
I thank my parents for encouraging me to obtain a higher education. I particularly thank my wife, Raj Lakhina, for her undying support of me throughout our married life and my children, Vanisha and Abhishek, for their love and moral support.

Finally, I would like to encourage young scientists to enter the fields of nonlinear plasma waves and nonlinear geophysics. "Go nonlinear, young man (and woman)!"

—Gurbax Lakhina, *Indian Institute of Geomagnetism, Navi Mumbai, Indi*

Cheng Receives 2015 Natural Hazards Focus Group Award for Graduate Research

Linyin Cheng will be awarded the Natural Hazards Focus Group Award for Graduate Research. This award recognizes a promising young scientist engaged in studies of natural hazards and risks and is given in recognition of outstanding contributions achieved during their Ph.D. (or highest equivalent terminal degree) research. She will be formally presented with the award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif.



Linyin Cheng

Linyin Cheng received her Ph.D. in hydrology and water resources from the University of California, Irvine (2014), and an M.Sc. in ice dynamics from Clarkson University (2011). Her doctoral research, advised by Dr. Amir AghaKouchak, focused on developing statistical frameworks for spatial-temporal nonstationary extreme value analysis. In 2013, she received the National Center for Atmospheric Research Graduate Student Visitor Program Award and an AGU Outstanding Student Paper Award. After her graduation, she received the Cooperative Institute for Research in Environmental Sciences (CIRES) postdoctoral fellowship (2014–2015) to work with Professor Balaji Rajagopalan at the University of Colorado, Boulder, and at the Physical Sciences Division (PSD) of the National Oceanic and Atmospheric Administration's (NOAA) Earth System Research Laboratory (ESRL). Currently, she is an associate research scientist at PSD, ESRL, NOAA, working with Dr. Martin Hoerling and Dr. Judith Perlwitz. Linyin's research interests include statistical analysis of climate and meteorological extreme events, spatial-temporal modeling of nonstationary processes, and statistical uncertainty analysis.

White Receives 2015 Ocean Sciences Early Career Award

Angelicque White will receive the 2015 Ocean Sciences Early Career Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award recognizes "significant contributions to and promise in the ocean sciences."

Angelicque White

Citation

For her contribution to the mechanistic understanding of exchanges of elements between microbial communities and surrounding seawater, it is my great pleasure to announce that Dr. Angelicque "Angel" White is the recipient of the 2015 AGU Ocean Sciences Early Career Award.

Angel's research focuses on the natural exchanges of elements between marine microbial communities and their environment. Highlights of her work include key advances on (1) how marine phosphorus dynamics modulates oceanic nitrogen fixation, a key source of new nitrogen in the tropics and subtropics, (2) the possible positive feedback mechanisms between mid–water column anoxia and surface nitrogen fixation, (3) mechanisms driving summer phytoplankton blooms in the subtropical North Pacific, and (4) new pathways of methane production in the surface ocean that may explain the decades-old mystery of surface water methane supersaturation.

Angel's insight and ability to creatively link a variety of disparate approaches have resulted in numerous high-impact publications that will be cited for years to come. Angel is also known for her superb communication skills and ability to work with others. She has initiated collaborations and contributed to projects with scientists from a number of institutes and raised several million dollars in grant funds from sources including the Alfred P. Sloan Research Fellowship, NASA, the National Science Foundation, and the Simons Foundation.

In addition to being a seagoing research scientist, Angel also finds time to contribute to substantial outreach and education while also participating in numerous services to the oceanographic community. This is well beyond the call of duty for a young soft-money scientist at this career stage. Given her current trajectory in the field, I am excited to see where Angel's research will lead next. I know it will continue to be exceptional.

—Claudia Benitez-Nelson, *University of South Carolina, Columbia*

Response

I would like to first thank Mark Abbott, Scott Doney, Fred Prahl, and Claudia Benitez-Nelson for the nomination as well as Adina Paytan and the Ocean Sciences section for selecting me. I also thank my colleagues in the College of Earth, Ocean and Atmospheric Sciences at Oregon State University for fostering a supportive and collaborative research environment.

Oceanography is a team sport. The research highlights cited above are not solely my own. They are all the result of strong collaborations and interdisciplinary science. And so, in receiving this award, I have to primarily acknowledge my colleagues for broadening my research, sharing their knowledge and skills, and expanding my intellectual horizons. Together, we have the privilege to study the oceans, to learn how they function, to outline the biological and physical structures, and to document change. The task is grand, formidable even. We dunk bottles into the ocean, we send little drones into the seas, we tether moorings and launch drifters, we scan the surface with satellites, yet in the end we see so very little of this immense, moving, alive, and fluid ocean.

Oceanography is a bold science. I can't imagine a more fulfilling career for myself. While it is an honor to have my work recognized by my peers, it is an honor that I share with my collaborators, students, and technicians.

—Angelicque White, *Oregon State University, Corvallis*

Rice Receives 2015 Ocean Sciences Award

Donald L. Rice will receive the 2015 Ocean Sciences Award at the 2015 AGU Fall Meeting, to be held 14–18 December in San Francisco, Calif. The award is given in recognition of outstanding and long-standing service to the ocean sciences.

Donald L. Rice

Citation

Don Rice is well known for his successful direction of the chemical oceanography program at the National Science Foundation (NSF) over the past 2 decades. The vibrant health of the program today, even within a declining research budget, speaks to his leadership, vision, and diligence in the pursuit of research excellence, a diverse portfolio, and cultivation of scientists at all career levels.

Don has been instrumental in developing the field of ocean biogeochemistry through his leadership in the Joint Global Ocean Flux Study (JGOFS) and the Ocean Carbon and Biogeochemistry program (OCB). His tactical skill in finding ways to support critical science informs his success as much as his intellectual acumen. JGOFS and OCB followed different programmatic models, and yet a third is employed for GEOTRACES, at the intersection of trace metal biogeochemistry, paleoceanography, and physical oceanography. Don's exemplary broad, balanced, and objective style of program management has advanced and nurtured ocean sciences.

Many of us go into science believing our work will one day benefit society, but for Don Rice, this responsibility is a centerpiece of his career. After establishing himself for his research in ocean sediment chemistry, Don obtained a master's degree in public health to help promote research on the impact of ocean processes on human health, as well as the impact of human activities on the health of the ocean. To this end, he serves as lead NSF program officer in the NSF–National Institute of Environmental Health Sciences Joint Program for Centers of Excellence in Ocean and Human Health. Both ocean and society are threatened by global warming, and Don has acknowledged this by his tenure on the U.S. Global Change Research Program's subcommittee on "Global Change and Human Health" since 1997, as well as the U.S. Global Change Research Program Carbon Cycle Interagency Working Group.

Don Rice's intellectual creativity extends beyond the ocean sciences, including mastery of Greek, Latin, and Sanskrit. He is truly a Renaissance man, making him uniquely deserving of the AGU Ocean Sciences Award.

—Robert F. Anderson, *Lamont-Doherty Earth Observatory, Palisades, N.Y.*

Response

I am deeply grateful to the AGU Ocean Sciences section for this award and to Bob Anderson, a longtime colleague-in-arms from the days of U.S. JGOFS down to U.S. GEOTRACES, for the kind words in his citation. Rewards for doing what one loves doing can come in many forms, but the recognition of one's peers is hard to beat.

My career as an NSF program officer came about quite by accident and, as far as I know, without malice aforethought. Beginning in 1990, Dr. Neil Andersen, my predecessor at the helm of the NSF Chemical Oceanography Program, began encouraging me come to NSF to serve as a rotator in the program. As ocean chemists in academia continue to do down to the present day when approached with such an alarming suggestion, I always had plenty of good reasons to decline. But I eventually ran out of excuses: my postdoc left for a real job, my anticipated new doctoral student got a better offer, and for the first time in 12 years my NSF grant was not renewed (for good reason, I will admit). In any event, I agreed to join up as a rotator "for one year, Neil." That was 1994. In 1997, when I was offered Neil's old job, I accepted it as an honor. I have had no regrets.

I am grateful to my family for their support for forbearance of my eccentricities and absences over the years, to my graduate students who taught me far more than I could ever have presumed to teach them, and to the hundreds of colleagues in the worldwide ocean sciences community who have made my life's work a joy and an adventure. I share this award with them all.

—Donald L. Rice, *National Science Foundation, Arlington, Va.*

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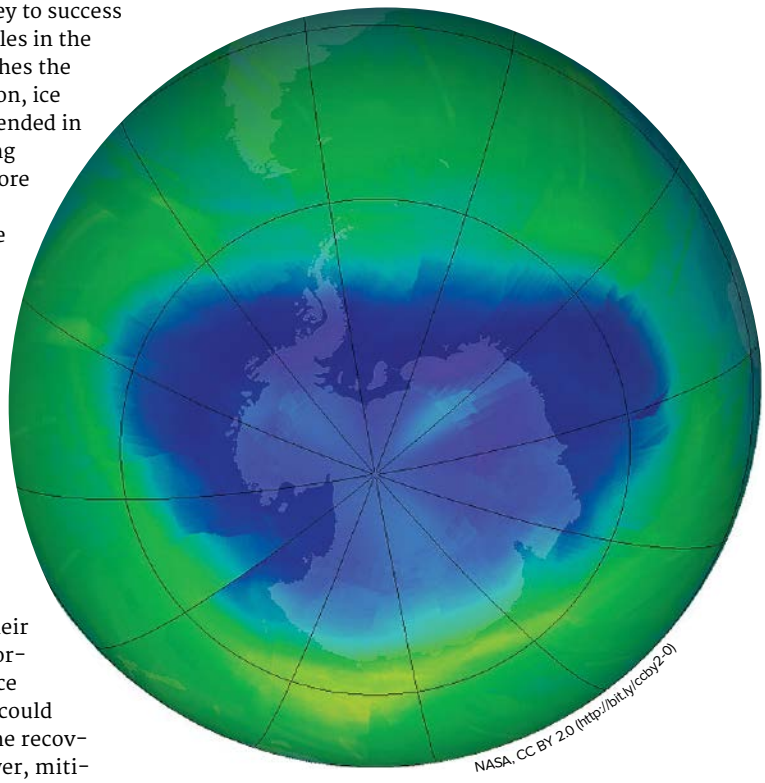
To Help Fix the Hole in the Ozone Layer, Just Add Ice

For better or for worse, the hole in the Earth's ozone layer above Antarctica has become a symbol of anthropogenic changes to the atmosphere since its discovery in the 1980s. Thirty years later, agreements between the world's nations, such as the Montreal Protocol, have reduced the quantity of ozone-depleting substances released into the atmosphere, and the hole is expected to close within the next 35–50 years. Although this is good news, harmful ultraviolet (UV) rays will continue to flood in through the area in the meantime, damaging life forms such as zooplankton, which form the base of the Antarctic ecosystem.

Nagase et al. propose a geoengineering solution that, according to their models, would help close the hole in the ozone layer faster without the risk of dangerous side effects. The chief culprit in ozone depletion is free chlorine, which forms when UV radiation from the Sun breaks down certain chlorine-containing molecules called chlorofluorocarbons. The highly reactive chlorine (Cl) atoms then combine with ozone (O_3) to form free oxygen and chlorine monoxide (ClO).

To solve this issue and help restore the ozone layer, the authors propose injecting tiny particles of ice into the atmosphere to remove a major chlorine-containing molecule, hydrochloric acid (HCl), before it has a chance to be broken down by the Sun and react with ozone. The scientists say that the key to success is to inject the tiny ice particles in the fall when little sunlight reaches the South Pole. During this season, ice particles would remain suspended in the air for several days, giving them time to absorb HCl before gradually dropping to lower altitudes and removing some of the chlorine present in the polar lower stratosphere.

Geoengineering is inherently risky; the authors are careful to clarify that their study is only an early investigation and that a great deal of additional work needs to be done before it would be advisable to begin injecting ice particles into the atmosphere on a large scale. If their computer simulations are correct, however, suspending ice droplets in the atmosphere could represent a way to hasten the recovery of the planet's ozone layer, mitigating some negative climate effects and protecting life on the planet's surface. (*Earth's Future*, doi:10.1002/2014EF000266, 2015) **—David Shultz, Freelance Writer**



The ozone hole above Antarctica, shown here in blue, is expected to close in the next 50 years, but scientists report that a geoengineering technique could hasten the process.

Largest Grains Dominate River Bedrock Erosion Rates

Established river (fluvial) bedrock erosion models, including the saltation-abrasion model (SAM), consider only a single representative particle (grain) size. An underlying assumption in current mechanistic models of fluvial bedrock erosion is that the rate of erosion in a river channel is proportional to the energy delivered to the bed by moving particles. These models do not address the extent to which channel erosion depends upon the sizes of the grains that the river transports.

To investigate the importance of grain size on bedrock erosion rates in the field, *Turowski et al.* measured the energy delivered by particle impacts to an instrumented channel in the Erlenbach (Alder Creek) near Brunni, Switzerland. By combining methods for measuring impact energy with automatic sensing of grain size distributions, the researchers show that the largest grains are the most important contributors to bedrock erosion. The team found that although the largest grain size class, with a median grain diameter of 86 millimeters, contributes an average of 8.8% of the total bed load mass, it is responsible for 41.5% of the energy delivered to the bed, a disproportionate effect not captured by SAM.

The researchers suggest that one reason for this effect may be that SAM does not currently account for all the different ways in which the grains flow downriver, including rolling and sliding. In particular, the model does not account for larger grain sizes, which are less likely to be transported by short hops known as saltation.

The finding that grain size strongly controls energy delivery to the bed adds considerable complexity to modeling channel and landscape evolution. The team suggests that it may be possible to focus future modeling on rare extreme events, which govern long-term erosion because they alone transport the largest grains. In addition, because grain size distributions in mountain rivers are largely determined by hillslope processes, the authors conclude that there is a need to better understand their role, as well as the role of lithology, in determining grain size distributions. (*Geophysical Research Letters*, doi:10.1002/2015GL063159, 2015) **—Terri Cook, Freelance Writer**

Jens Turowski

Measurement cross section in an instrumented hydrologic catchment in the Erlenbach near Brunni, Switzerland. Instruments shown include Swiss plate bed load surrogate monitoring sensors, basket samplers, and erosion slabs.

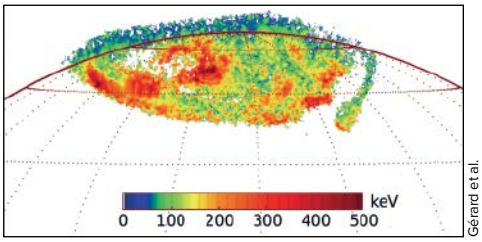
How Powerful Is Jupiter's Aurora?

Earth is not the only planet with beautiful auroral displays—Jupiter boasts some of the most powerful in the solar system. Unlike Earth's, which emit mostly in the visible spectrum, Jupiter's aurora is mostly in the ultraviolet (UV) part of the spectrum. Over the past 2 decades, NASA's Hubble Space Telescope has returned some awesome images of the shimmering curtains around the poles of the gas giant. Like Earth's aurora, Jupiter's is caused by showers of energetic particles that rain down on the upper atmosphere, exciting atoms and causing them to glow.

Now *Gérard et al.* have gone one step further, using Hubble to measure just how energetic these incoming particles, which in Jupiter's case are mostly electrons, can be. They used one of Hubble's spectrographs, an instrument that measures the spectrum of light—as if shining it though a prism and capturing the resulting rainbow. The methane in Jupiter's atmosphere absorbs only the most energetic UV light, leaving longer wavelengths untouched. The most energetic incoming electrons penetrate the deepest into Jupiter's atmosphere, producing a UV glow closer to the surface. Because this light must travel through more of the atmosphere on its return to space, more of it is absorbed before it reaches Hubble's spectrograph.

To map where the more energetic electrons were, the team used an elegant method: panning Hubble's eye across the disk of Jupiter at a constant rate and using a special mode of the instrument that tags every bit of light it detects with a time stamp, so that they could later reconstruct what bit of light came from which part of Jupiter.

The new maps could provide insight into one of Jupiter's most enduring mysteries—why its upper atmosphere is so hot. Decades of measurements show that Jupiter's atmosphere contains much more heat than would be expected if its only source of energy were incoming sunlight. The aurora may play a role in this extra heating. The amount of energy the electrons deposit in the upper atmosphere is enormous, on the order of 10 terawatts, the equivalent of about 10,000 nuclear reactors—much greater than the amount of energy that Jupiter absorbs from the Sun. Understanding where the aurora-inducing electrons are depositing the most heat is crucial to helping scientists unravel how these electrons might be affecting the overall balance of heat in Jupiter's atmosphere. (*Journal of Geophysical Research: Space Physics*, doi:10.1002/2014JA020514, 2014) **—Mark Zastrow, Freelance Writer**



Gérard et al.

An electron energy map could provide insight into why Jupiter's upper atmosphere is so hot.

Microbial Communities Form Iron Shells in Abandoned Mines

High in the Pyrenees Mountains, deep in abandoned mines, scientists discovered peculiar black shells that seem to crop up of their own accord on metal surfaces. These bulbous protrusions coat steel pipes, cables, and rods left behind by the miners, and now researchers think they know why they form.

Through careful analysis of the shells' composition and structure, *Fernández-Remolar et al.* concluded that microbes—fungi primarily—form the shells, depositing iron oxide and other minerals as part of their natural metabolism.

The clam-like structures—composed of an upper and lower shell—have a rough symmetry to them and always grow outward from a single point of attachment. Electron microscopy revealed small-scale, fiber-like crystals arranged into lines growing outward from the steel surface. The shells appear to be formed layer by layer, with crystal size and composition varying across layers.

To determine what sorts of microbes might be laying down the mineral layers, scientists used spectrometric techniques in combination with an antibody-covered chip originally designed to search for life on other planets. Specifically, the team analyzed cave environments by testing for 300 different components of microbial cells, such as DNA, proteins, and other biomolecules, to generate a fingerprint of what sort of organisms might be present.

The researchers report that fungal filaments, which sequester iron ions from the mine waters, appear to be the dominant players in the shells' formation, especially in the latter stages of development after the base layers have been laid down by bacteria. The result of this complex interplay between microbes and iron-rich water is a rapid biomineralization process that sprouts iron-rich shells from the surface of steel structures. (*Journal of Geophysical Research: Biogeosciences*, doi:10.1002/2014JG002745, 2015) **—David Shultz, Freelance Writer**

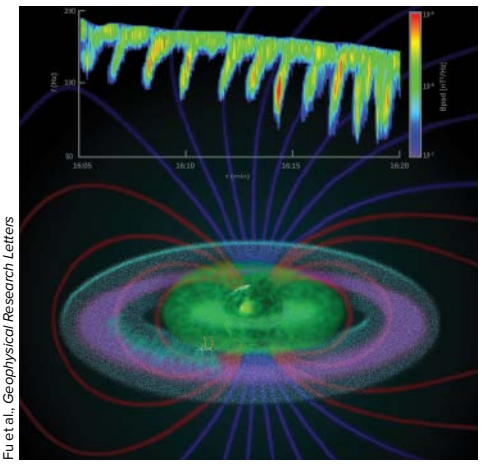
Joan Santamaría

Microbes build clam-like shells on the surfaces of steel objects left behind in abandoned mines.

Spacecraft Records Rising-Tone Magnetosonic Waves

Magnetosonic (MS) waves, also known as equatorial noise, are electromagnetic emissions occurring near the magnetic equator. They get their energy by interacting with protons trapped in Earth's magnetic field, spiraling around magnetic field lines. Historically, the frequencies of MS waves were believed to be "temporally continuous"—that is, varying smoothly, like a trombone player sliding from one note to the next. This indicated a simple linear interaction between MS waves and protons *Fu et al.* report a possible complication to this picture: a sharp rising tone in their spectrogram, like a flute player performing a series of runs and trills.

A rising tone suggests a more complicated, nonlinear series of interactions between the MS waves and protons. Scientists have observed rising-tone features in other kinds of plasma waves, including chorus and electromagnetic ion cyclotron (EMIC) waves. In those waves, the web of forces between the particles creates currents that boost the wave's frequency. However, scientists had never seen this behavior in MS waves.



Fu et al., *Geophysical Research Letters*

As the Time History of Events and Macroscale Interactions during Substorms (THEMIS) spacecraft traveled from the Earth's plasmasphere (green) to the outer radiation belt (pink) it observed a previously unknown plasma wave, partly sound and partly electromagnetic, that could affect space weather.

The team used data collected from two specific events recorded by NASA's Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission. The THEMIS spacecraft orbits in the magnetosphere near Earth's magnetic equator and collects data from magnetic storms, the boundary of the magnetosphere on the dayside, and Earth's radiation belts.

The first event, observed in June 2010, revealed electromagnetic emissions of rising-tone MS waves. The authors studied a second rising-tone MS wave event, observed in August 2010, to eliminate the possibility that the previous rising-tone MS wave emissions were a one-time event. On the basis of the rising-tone feature of MS waves, the scientists concluded that MS waves were possibly generated from nonlinear interactions. (Visit http://bit.ly/THEMIS_2015 to listen to a sample of the rising-tone MS waves).

The team found that chorus and EMIC waves were more powerful than the MS waves, indicating that particles interact more efficiently with those waves than with MS waves. (*Geophysical Research Letters*, doi:10.1002/2014GL061867, 2014) **—Catherine Minnehan, Freelance Writer**

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Atmospheric Sciences

Postdoctoral Research Associate

The Shepson Tropospheric Chemistry Research Group at Purdue University has an opening for a Postdoctoral Research Associate. The position involves work aimed at developing and improving methods for quantification of sources and sinks of greenhouse gases, focusing on aircraft-based methods. This work is part of the Indianapolis Flux Experiment (INFLUX). Depending on interests, there may also be an opportunity to lead, and to work on a number of other problems in atmospheric chemistry, including:

1. Nitrogen cycling in forest environments
2. Aerosol phase photochemistry
3. Arctic halogen chemistry and analytical mass spectrometry

Expertise in atmospheric analytical chemistry and laboratory methods is essential. The position is for one year, but potentially renewable annually. The position will be open until filled. Interested candidates should send a CV with a list of 3 references to:

Prof. Paul B. Shepson
Purdue University
560 Oval Dr.
West Lafayette, IN 47907
765-494-7441
pshepson@purdue.edu

Purdue University is an ADVANCE Institution. Purdue University is an EEO/AA employer fully committed to achieving a diverse work force. A background check will be required for employment in this position.

Tenure-track position in Climate Dynamics, University of Colorado, Boulder

The Department of Atmospheric and Oceanic Sciences (ATOC) at the University of Colorado Boulder, invites applications for a tenure-track faculty position in climate dynamics. We are seeking a person who will develop a vibrant research program complementing existing strengths within ATOC, on the Boulder Campus, and in the Boulder research community, and who is committed to excellence in undergraduate and graduate teaching. The position will be filled at the Assistant Professor level. Review of applications will begin on Nov. 15, 2015, and will continue until the position is filled. A Ph.D. in Atmospheric Science, Oceanography, or a related field is required at the time of appointment, and post-doctoral experience is preferred. Informal inquiries can be made to the chair of the search committee, Jeffrey Weiss, at ClimateDynamicsATOC@colorado.edu. The University of Colorado is an Equal Opportunity/Affirmative Action employer.

Applications are accepted electronically at http://www.jobsatcu.com/postings/107586.

After November 4th, you will be redirected to CU Careers, our new

career site. In order to access this posting, please use the keyword search for posting #F02886.

The Atmospheric and Oceanic Sciences Program at Princeton University, in association with NOAA's Geophysical Fluid Dynamics Laboratory (GFDL), seeks two postdoctoral or more senior researchers:

1) To analyze observational datasets, including satellite data, airplane reconnaissance data, and reanalysis data, to validate the tropical cyclones (TCs) in weather-scale and subseasonal-to-seasonal (0-90 day) simulations of GFDL HiRAM, of resolutions ranging from 25 (global) to 1 km (refined grid). Topics of interest include the TC thermodynamic structure, rainbands, eyewalls, and convective elements? TC rainfall studies? TC extratropical transition? the interaction between TC and large-scale circulation? short-term forecasts to seasonal predictability.

2) To conduct frontier studies on the genesis mechanism and predictability of severe convective storms over the continental Unites States using available satellite and radar observations and a newly-developed global cloud-resolving model with refined-grid capability, for the validation and the ultimate goal of transitioning the prediction capability into operational forecasting.

Each selected candidate must have a Ph.D. in meteorology, atmospheric sciences, or a related field. The candidates will have substantial backgrounds in observations, theory, and/or modeling in tropical meteorology (e.g., tropical cyclones), convective-scale storms (e.g., supercell), and associated analysis skill, to develop tools to aid GFDL model developers in building a next generation multi-scale prediction system for high impact weather events.

The positions are for one year renewable for up to three years pending satisfactory progress and continued funding. Interested candidates should contact Shian-Jiann Lin (shian-jiann.lin@noaa.gov), Jan-Huey Chen (jan-huey.chen@noaa.gov), and/or Lucas Harris (lucas.harris@noaa.gov) for further information.

Complete applications, including a CV, publication list, 3 letters of recommendation, and a one-to-two page statement of research interests should be submitted by December 1, 2015 for full consideration, though evaluation will be ongoing until suitable candidates are identified. Applicants should apply online to http://jobs.princeton.edu, Requisition #1500814. This position is subject to the University's background check policy. Princeton University is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law.

PRINCETON UNIVERSITY

PRINCETON GEOSCIENCES

Assistant Professorships in Climate Science, Department of Geosciences, Princeton University

The Department of Geosciences at Princeton University seeks two climate scientists, broadly defined, to be considered for tenure-track positions at the assistant professor level. The areas of focus for the search are: i) the global carbon cycle and global biogeochemical dynamics, including their history, and ii) field- or laboratory-based paleoclimate studies. The expectation is that one faculty member will be hired in each of these areas. We are particularly interested in scientists who will diversify and extend the climate-related research activities of the department as well as enhance collaboration across the university.

Applicants should submit a curriculum vitae, including a publication list, a statement of research and teaching interests, and contact information for three references to http://jobs.princeton.edu. Evaluation of applications will begin immediately; interviews of candidates will begin in February 2016 and will continue until the positions are filled.

Princeton University is an Equal Opportunity Employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law. This position is subject to the university's background check policy.

Biogeosciences

Assistant Professor, Environmental Sciences

The University of Virginia College and Graduate School of Arts & Sciences Department of Environmental Sciences invites applicants for a tenure-track Assistant Professor position in remote sensing of Earth surface processes. We seek candidates who are dedicated to our mission and passionate about research and teaching in a world-class institution. Examples of research areas that would strengthen and enhance our existing program include, but are not limited to, the application of remote sensing to hydrological, geomorphological, ecological, and atmospheric processes, especially as related to land use, land surface, and climate change. Regardless of research focus, we wish to hire an outstanding scientist who will thrive in an interdisciplinary department.

In addition to developing external funding to support research endeavors, candidates will be expected to teach at the graduate and undergraduate levels and provide service to the University, Department, and professional organizations.

Review of applications will begin November 15, 2015. The anticipated appointment start date will be August 25, 2016. Applicants must be on track to receive a Ph.D. in the relevant field by May 2016 and must hold a Ph.D. at the time of appointment. Successful candidates will be expected to teach an introductory course on remote sensing from a physical basis to upper-level undergraduate and graduate students, along with a follow-on class on remote sensing applications at a similar level.

To apply candidates must submit a Candidate Profile through Jobs@UVa (https://jobs.virginia.edu), search on posting number 0617276 and electronically attach the following: a cover letter of interest describing research agenda and teaching experience, a curriculum vitae, sample publications submitted as writing sample 1, and contact information for three references.

Questions regarding the position should be directed to: Todd Scanlon, tms2v@virginia.edu. Questions regarding the application process in JOBS@UVa should be directed to: Rachel Short, rbs2n@virginia.edu, 434-924-7763.

The University will perform background checks on all new faculty hires prior to making a final offer of employment.

The University of Virginia is an equal opportunity/affirmative action employer. Women, minorities, veterans and persons with disabilities are encouraged to apply.

Geochemistry

Aqueous and Environmental Geochemistry Position:

The Department of Geosciences at the University of Massachusetts invites applications for a tenure track position in Aqueous and Environmental Geochemistry at the Assistant Professor level starting Fall 2016. We are seeking talented applicants qualified for an assistant professor position. Under exceptional circumstances, highly qualified candidates at other ranks may receive consideration.

A Ph.D. in Geosciences or related field is required at the time of appointment and post-doctoral experience is preferred.

The successful candidate will have research interests within the broad area covered by the position title. These areas might include critical zone and near-surface weathering, processes that occur at solid-water interface, including biological interactions, or chemical, physical and biological processes controlling the transport of dissolved species. It is hoped that the candidate will have interests in isotope or trace element geochemistry and the application of geochemical tools to a broad range of scientific questions.

Research within the Department of Geosciences revolves around four main clusters: Global Change and Surface Processes; Water; Dynamic Earth; and Geography, Society and the Environment. It is expected that successful candidate will develop a rigorous externally funded research program and contribute to one or more of these research themes. Candidates who have experience in integrating geochemical tools with quantitative approaches to solving problems in natural systems are especially encouraged Field-oriented research that could be incorporated into both undergraduate and graduate courses will be an asset. Teaching will involve participation in a large-enrollment introductory course in addition to appropriate advanced undergraduate and graduate courses.

Applicants must submit a cover letter, CV, research statement, teaching statement, and contact information for three referees familiar with their research and teaching efforts to: http://umass.interviewexchange.com/jobofferdetails.jsp?JOBID=64033. For more information, visit the Department of Geosciences website (www.geo.umass.edu) or contact the Search Committee Chair (search@geo.umass.edu). Review of applicants will begin 16 November 2015 and continue until the ideal candidate is identified.

The university is committed to active recruitment of a diverse faculty and student body. The University of Massachusetts Amherst is an Affirmative Action/Equal Opportunity Employer of women, minorities, protected veterans, and individuals with

disabilities and encourages applications from these and other protected group members. Because broad diversity is essential to an inclusive climate and critical to the University's goals of achieving excellence in all areas, we will holistically assess the many qualifications of each applicant and favorably consider an individual's record working with students and colleagues with broadly diverse perspectives, experiences, and backgrounds in educational, research or other work activities. We will also favorably consider experience overcoming or helping others overcome barriers to an academic degree and career.

Environmental Chemistry Faculty Position - University of Montana

The Department of Chemistry and Biochemistry at the University of Montana - Missoula invites applications for a tenure-track faculty position in Environmental Chemistry at the Assistant Professor level to begin August 2016. We welcome applications from scientists with expertise in any area of environmental chemistry. Postdoctoral experience is required. The successful candidate will be expected to teach general, analytical or environmental chemistry courses at the undergraduate and graduate level. We are a small Ph.D. granting department with 15 tenure-line faculty and ~25 graduate students with a strong extramural research program. Excellence in research and undergraduate and graduate education are expected. See http://hsweb.hs.umt.edu/chemistry/default.php for more information about the Department and University.

UM, the College of Humanities and Sciences, and the Department embrace diversity as a core value. Applications from persons with diverse backgrounds are especially welcome.

Screening of applications will begin on November 15, 2015 and will continue until the position is filled. Applicants are required to submit all application materials, including a letter of intent, full CV, a summary of research plans, a statement of teaching philosophy and three letters of recommendation to: http://bit.ly/1367chem. Inquiries should be directed to the Department at: chemistry@umontana.edu The University of Montana is an ADA/EOE/AA/Veteran's Preference Employer.

Geochemistry Lab Manager

The Department of Geology and Environmental Earth Science at Miami University invites applications for a Geochemistry Lab Manager. The Lab Manager will be expected to manage new trace metal geochemistry and ICP-OES labs, and to share responsibility for ICP-MS, HPLC and powder XRD labs. Duties will include training and supervision of lab users, laboratory maintenance, data quality assurance, assistance in teaching laboratory-based courses, oversight of radiation and environmental health and safety compliance, and laboratory financial management. Laboratory technique development and adaptation for analysis of diverse geologic and environmental materials expected, with opportunities to pursue research and external funding. Required: M.S. or Ph.D. in geology or related field, at least 4 years of experience in major and trace element analysis of geologic materials by plasma techniques at the time of the appointment, and proven experience in successful training and supervision of geochemistry lab users. Desired: experience in powder XRD and HPLC analysis; expertise in laboratory technique development, computer programming and electrical and mechanical abilities. Submit cover letter, vita and unofficial copy of transcripts to: https://miamioh.hiretouch.com/jobdetails? jobID=1868. Arrange to have three (3) letters of recommendation sent to GeochemistrySearch@miamioh.edu. Screening of applications will begin January 15, 2016 and continue until the position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety

Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html.

Criminal background check required. All campuses are smoke- and tobacco-free.

Postdoctoral Fellowship Positions in Geochemistry, Cosmochemistry, and Astrobiology

Carnegie Institution, Department of Terrestrial Magnetism, Washington, DC

Openings are available beginning Fall 2016 for postdoctoral fellowships in the fields of geochemistry, cosmochemistry, and astrobiology that provide support for creative independent research of the applicant's choosing. Details on DTM research staff, laboratory facilities, and ongoing research can be found at dtm.carnegiescience.edu. Fellowships are for one year and are normally renewable for a second year.

Applications should be submitted online at https://jobs.carnegiescience.edu/jobs/dtm and should include a curriculum vitae and list of publications, description of thesis research, a short (2-3 page) statement of research plans for the fellowship period, and three letters of recommendation by those familiar with your work. Submission details are available when you click on "Apply Now." Creativity in the proposed research figures heavily in the evaluation of the application. Review of the applications will begin on December 1, 2015. Address any questions you have to geochemfellowship@dtm.ciw.edu. Carnegie Institution is an Equal Opportunity Employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of gender, race/ethnicity, protected veteran status, disability, or other protected group status.

Tenure-track Faculty Position in Mantle Processes

The Department of Geological Sciences seeks an outstanding scientist to lead a vibrant research program in the broadly defined area of Mantle Processes. Specific areas of interest include (but are not limited to) the composition, structure, and evolution of our planet over varying length and time scales. We are particularly interested in those who seek to make connections between deep and shallow processes (examples include how the dynamically flowing and recirculating mantle interacts with its crust, hydrosphere, and atmosphere). Research approaches should encompass some combination of field, laboratory, and modeling. The appointment will preferably be at the junior level (Assistant or untenured Associate Professor), but applications from scientists at all career levels will be considered. The successful applicant will be expected to develop a world-class independent program of research, interface where appropriate with existing programs in the Geological Sciences and in the School of Earth, Energy, and Environmental Sciences, and teach at the undergraduate and graduate level.

Applications should include a cover letter, curriculum vita, a statement of research and teaching interests, three recently-published representative papers, and the names and email addresses of three individuals from whom the search committee can request letters of reference. Please apply at: https://academicjobsonline.org/ajo/jobs/6199

Review of applications will commence October 31, 2015. The position will remain open until filled. Questions can be directed to. Lauren Nelson at lmnelson@stanford.edu

Stanford University is an equal opportunity employer and is committed to increasing the diversity of its faculty. It welcomes nominations of and applications from women, members of minority groups, protected veterans and individuals with disabilities, as well as from others who would bring additional dimensions to the university's research and teaching missions.

University of Tennessee, Knoxville Faculty position in planetary petrology/mineralogy/geochemistry

The Department of Earth & Planetary Sciences at The University of Tennessee seeks to fill a faculty position in petrology/mineralogy/geochemistry with emphasis in planetary geoscience. The position is for an open-rank (tenure-track or tenured); we would prefer to select a candidate at the Associate or Full Professor level, but welcome applications for Assistant Professor. The position begins August 1, 2016. The University of Tennessee, Knoxville is a Research I University and the flagship campus of the UT system. The Department (http://eps.utk.edu) focuses on geology and has an active emphasis on planetary research through its Planetary Geosciences Institute (http://web.utk.edu/~pgi). Requirements for the position are: Ph.D. in geology or a related field, and demonstrated research experience in planetary geoscience.

The successful candidate is expected to conduct a robust, funded program of planetary research, mentor graduate

students, effectively teach courses in petrology and/or mineralogy at the undergraduate and graduate levels, and collaborate in department research dealing with petrology, mineralogy, geochemistry, and solar system exploration. Salary and benefits are competitive and commensurate with experience. The Knoxville campus of the University of Tennessee is seeking candidates who have the ability to contribute in meaningful ways to the diversity and intercultural goals of the University.

To apply, please email the following to mcsween@utk.edu: C.V., cover letter describing research and teaching experience and plans, and names of 4 references with contact information. Applications received by December 15, 2015 are ensured review, but earlier submission is encouraged. The position will remain open until filled. Questions about the position should be directed to H. McSween.

The University of Tennessee is an EEO/AA/Title VI/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment without regard to race, color, national origin, religion, sex, pregnancy, marital status, sexual orientation, gender identity, age, physical or mental disability, or covered veteran status.

Hydrology

Assistant Professor of Hydrology - New Mexico Tech

The Department of Earth and Environmental Science at New Mexico Institute of Mining and Technology (NMT) invites applications for a tenure-track Assistant Professor position in the Hydrology Program. This will be a joint appointment between Academic Affairs and the Geophysical Research Center.

Applicants should have a Ph.D. in Earth Science, Civil Engineering, Environmental Engineering, or a related field at the time of appointment. We seek candidates with a specialty in vadose-zone hydrology. Candidates with additional expertise in hydrologic remote sensing, land-surface/atmosphere interaction, and land-surface dynamics will receive preference. Potential for excellence in teaching and research are the most important qualifications. Women and underrepresented minorities are encouraged to apply.

Responsibilities will include developing an active program of extramurally funded research, supervising and supporting graduate students, and teaching two graduate or undergraduate courses per year.

The successful candidates will join a group of five hydrologists including four full-time hydrology faculty, two emeritus faculty, eight adjunct faculty, and 25 graduate students. The Department of Earth and Environmental Science has 16 faculty and about 50 undergraduate and 65 graduate students. NMT is the academic partner of the National Cave and Karst Research Institute (NCKRI), based in Carlsbad, NM. Additional geoscience professionals on campus include over 30 staff members of the New Mexico Bureau of Geology and Mineral Resources, plus faculty and researchers in the Petroleum Recovery Research Center, the Petroleum and Mineral Engineering departments and the IRIS PASSCAL Instrument Center. For detailed inquiries, contact search committee chair, Mark Person (mperson@nmt.edu).

Applicants should submit a letter of interest, resume, a statement of teaching and research interests, one representative publication and the names of three references to Hydrology Search, Box 136, Human Resources, New Mexico Institute of Mining and Technology, 801 Leroy Pl., Socorro, New Mexico 87801. College transcripts will be required if selected to interview. Review of application material will begin on October 1, 2015. The search will remain open until the position is filled. Email applications are not accepted. New Mexico Tech is an equal opportunity/affirmative action employer.

TENURE-TRACK ASSISTANT PROFESSOR: HYDROGEOLOGY CALIFORNIA STATE UNIVERSITY NORTHRIDGE

The Department of Geological Sciences at California State University, Northridge invites applications for a full-time tenure-track faculty position at the level of Assistant Professor in hydrogeology. We offer B.S. and M.S. degrees in Geology and in Geophysics. The successful candidate must have a Ph.D. at the time of appointment. Experience in postdoctoral research and/or University-level lecture instruction is desirable. We seek an innovative hydrogeologist with technical expertise in one or more of the following fields: subsurface measurement and modeling of groundwater flow, reactive transport modeling, or remote and/or geophysical sensing of groundwater. Research areas may include, but are not limited to, local and regional-scale groundwater dynamics and groundwater quality; the impact

of climate change on groundwater recharge, storage and use; water injection and/or withdrawal and induced seismicity; or groundwater transport of contaminants. We particularly seek candidates who both complement our current research program and integrate across sedimentology, stratigraphy and geophysics. The successful candidate is expected to develop a vigorous research program, which includes seeking extramural funding, publishing peer-reviewed papers, and involving undergraduate and M.S. students. Furthermore, the successful candidate is expected to demonstrate teaching excellence and provide effective instruction to students of diverse backgrounds in a multicultural setting. Potential classes to be taught by the new hire include: a new undergraduate core course in Earth Systems, general education courses in water resources and environmental geology and elective offerings at the upper-division and/or graduate level in the candidate's research specialty.

Applicants should submit a cover letter, CV, the names and full contact information for three references, statement of teaching philosophy and experience, and statement of research interests. Electronic submissions are strongly encouraged and should be sent to: geology.hydro.search@csun.edu. Materials can also be sent to: Hydro Search Committee, Department of Geological Sciences, California State University Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8266. Review of applications will begin 1 January 2016. Priority will be given to applications received by this date, but the position remains open until filled. For additional information, see http://www.csun.edu/geology. The University is an EO/AA employer.

Ocean Sciences

Research Position: Modeling US landfalling hurricane and storm surge risk under global warming conditions

The Atmospheric and Oceanic Sciences Program at Princeton University in cooperation with NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) seeks a postdoctoral research associate or more senior scientist to explore U.S. landfalling hurricanes and their associated storm surge risk under present-day and future warm-climate conditions. As part of a new NSF funded project, the researcher will collaborate with an interdisciplinary team of scientists from GFDL/NOAA, Princeton University, and MIT to investigate how various aspects of projected 21st century climate change may alter storm surge risk for the mainland U.S. coast. The incumbent will use dynamical hurricane modeling frameworks developed at GFDL, including the GFDL hurricane model, together along with established storm surge modeling techniques to explore future projections. Research is needed to better understand how surge risk is likely to change due to influences of changes in sea level, with a particular emphasis on improved understanding of projected changes in hurricane climate (tracks, intensity, storm structure, etc.) that can affect storm surge risk. Scientifically sound information on these issues, including assessments of remaining uncertainties, are urgently needed to help inform decision-making for risk management, adaption, and policy responses.

Candidates with strong quantitative and analytical backgrounds in atmospheric science, including dynamical modeling and the analysis of large data sets and/or model output, are particularly encouraged to apply. This is a full-time, one year position (subject to renewal after the first year contingent upon satisfactory performance) based at GFDL in Princeton, New Jersey. Interested candidates may contact Thomas Knutson (Tom.Knutson@noaa.gov) or Gabriel Vecchi (Gabriel.A.Vecchi@noaa.gov) for further information. Complete applications, including a CV, publication list, 3 letters of recommendation, and a one-to-two page statement of research interests should be submitted by November 15, 2015 for full consideration, though evaluation will be ongoing until a suitable candidate is identified. Applicants should apply online to http://jobs.princeton.edu, Requisition #1500773.

This position is subject to the University's background check policy. Princeton University is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, disability status, protected veteran status, or any other characteristic protected by law.

Solid Earth Geophysics

John W. Miles Postdoctoral Fellowship In Theoretical And Computational Geophysics

The Institute of Geophysics and Planetary Physics (IGPP) at Scripps Institution of Oceanography has opening for the John W. Miles Postdoctoral Fellowship in Theoretical and Computational Geophysics in 2016. Funding from the Green Foundation for Earth Sciences is available to fully support a postdoctoral position in the broad areas of computational and theoretical geophysics. Applicants are encouraged to contact potential mentors at IGPP prior to the application deadline. The position is available for one year for applicants <5 yr from PhD degree, and is renewable for a second year subject to satisfactory performance and availability of funds. Salary starts at $60,000/yr plus benefits and depends on experience.

Junior Tenure-Track Faculty Position
Earth Surface Processes
Dartmouth College

The Department of Earth Sciences at Dartmouth College invites applications for a junior rank tenure-track position in the general area of Earth Surface Processes. We especially welcome applications from candidates with research interests in the generation, transport and deposition of sediments and related contaminants in hill slope and stream channel environments, potentially with additional research interests in the biological mediation of physical processes and forms. Particular attention will be given to candidates who combine a focus on understanding fundamental processes with state-of-the-art laboratory and/or field research programs that complement and contribute to ongoing research activities in the Department as well as in Dartmouth's Department of Biological Sciences, Department of Geography, and the Thayer School of Engineering. The successful candidate will continue Dartmouth's strong traditions in graduate and undergraduate research and teaching. Teaching responsibilities consist of three courses spread over three of four ten-week terms.

The Department of Earth Sciences is home to 11 tenured and tenure-track faculty members in the School of Arts and Sciences, and enjoys strong Ph.D. and M.S. programs and outstanding undergraduate majors. To create an atmosphere supportive of research, Dartmouth College offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence, and flexible scheduling of teaching responsibilities.

Dartmouth College, a member of the Ivy League, is located in Hanover, New Hampshire (on the Vermont border). Dartmouth has a beautiful, historic campus located in a scenic area on the Connecticut River. Recreational opportunities abound all year round. To learn more about Dartmouth College and the Department of Earth Sciences, visit http://www.dartmouth.edu/~earthsci.

To submit an application, send curriculum vitae, statements of teaching and research interests and objectives, reprints or preprints of up to three of your most significant publications, and the name, address (including street address), e-mail address and fax/phone numbers of at least three references to: **http://apply.interfolio.com/30984**
Applications received by November 11, 2015 will receive first consideration. The appointment will be effective July 1, 2016.

Dartmouth College is an equal opportunity/affirmative action employer with a strong commitment to diversity. In that spirit, we are particularly interested in receiving applications from a broad spectrum of people, including women, minorities, individuals with disabilities, veterans or any other legally protected group.

Applications including a statement of research interests (1–2 pages), dissertation abstract (1 page), curriculum vitae with publications, and contact information for two recommendation letter writers should be submitted online at http://igpp.ucsd.edu/greenfoundation/application.

Review of applications will begin on November 12, 2015. Please address questions to Donna Blackman, Green Foundation Secretary dblackman@ucsd.edu.

Internet/Unlimited Text: "UC San Diego is a Equal Employment Opportunity (EEO) employer and welcomes all qualified applicants. Applicants will receive fair and impartial consideration without regard to race, sex, color, religion, national origin, age, disability, veteran status, genetic data, or other legally protected status."

Print/Limited Text: "EOE/Minority/Female/Disability Vets."

Position Announcement
Department of Marine,Earth, and Atmospheric Sciences

Assistant/Associate Professor- Sedimentary Basin Analysis

The Department of Marine, Earth, and Atmospheric Sciences (MEAS) at North Carolina State University (NC State) intends to fill a junior (Assistant I Associate Professor) tenure-track faculty position in sedimentary basin analysis. Possible research areas include,but are not limited to, the relationship of basin evolution to mantle processes,linkages of stratigraphy to landscape evolution as a function of tectonics, climate, and sea- level change, the prediction of sub-surface porosity and permeability to model the movement of water and hydrocarbons, and the use of stratigraphy in paleo-environmental and paleo-biological studies. The starting date for this position is 15 August 2016. Candidates that combine surface and/or subsurface observations with numerical simulations, analogue models, or laboratory experiments to investigate the geologic history of sedimentary basins are preferred, and applicants should have a strong interest in interdisciplinary collaborations across and beyond the geosciences.

Applicants must hold a Ph.D. degree in the geosciences or a related field. Postdoctoral experience is preferred, but not required. The successful candidate must demonstrate strong potential for outstanding accomplishments in research, research supervision, and teaching. The successful applicant will be expected to teach an undergraduate-level course in stratigraphy, as well as other undergraduate and graduate classes commensurate with the candidate's interest and expertise. An interest in participating in the Department's capstone undergraduate geology field course also is desirable. MEAS places a high value on excellent instruction and the use of innovative teaching methods.

Affiliated with the College of Sciences at NC State, MEAS is one of the largest interdisciplinary geoscience departments in the nation. Opportunities exist for disciplinary and interdisciplinary interactions with more than 30 marine,earth, and atmospheric scientists. Additional information about the department and its facilities can be found on the web page: http://www.meas.ncsu.edu.

Review of applications will begin on 15 November 2015; the position will remain open until filled. Applications, including cover letters, curriculum vitae, teaching and research statements, and contact information for three references must be submitted online at http://jobs.ncsu.edu/postings/57829

Founded in 1887, NC State is a land-grant institution distinguished by its exceptional quality of research, teaching, extension, and public service. Located in Raleigh, North Carolina, NC State is the largest university in North Carolina, with more than 34,000 students and 8,000 faculty and staff. National rankings consistently rate Raleigh and its surrounding region among the five best places in the country to live and work, with a highly educated workforce, moderate weather, reasonable cost of living,and a welcoming environment. A collaborative, supportive environment for business and innovation and research collaborations with area universities and the Research Triangle Park are compelling reasons for relocation to the area. NC State is an equal opportunity and affirmative action employer. All qualified applicants will receive consideration for employment without regard to race,color, national origin, religion, sex,sexual orientation,age, veteran status,or disability. Applications from women, minorities, and persons with disabilities are encouraged.

Postdoctoral Fellowship Positions in Geophysics, Volcanology, Planetary Science

Carnegie Institution, Department of Terrestrial Magnetism, Washington, DC

Openings are available beginning Fall 2016 for postdoctoral fellowships in the fields of terrestrial or planetary geophysics and volcanology. These fellowships provide salary, travel, and research support for creative independent research of the applicant's choosing. Details on DTM research staff, laboratory facilities, and ongoing research can be found at dtm.carnegiescience.edu. Fellowships are for one year and are normally renewable for a second year.

Applications should be submitted online at https://jobs.carnegiescience.edu/jobs/dtm and should include a curriculum vitae and bibliography, description of thesis research, and a short (2–3 page) statement of research plans for the fellowship period. Appli-

cants are also encouraged to contact a current staff member to discuss research plans. Creativity in the proposed research figures heavily in the evaluation of the application. Three letters of recommendation by those familiar with your work should also be submitted online. Submission details are available when you click on "Apply Now." Review of the applications will begin on December 1, 2015. Please email any questions you have to geofellowship@dtm.ciw.edu. Carnegie Institution is an Equal Opportunity Employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of gender, race/ethnicity, protected veteran status, disability, or other protected group status.

Space Physics

TENURE-TRACK ASSISTANT PROFESSOR FACULTY POSITION IN THEORETICALAND COMPUTATIONAL PLASMA PHYSICS Department of Physics and Astronomy, Dartmouth College

Applications are invited for a faculty position in Theoretical and Computational Plasma Physics, with a preferred starting date of Fall 2016. Consideration will be given to applicants at the assistant professor level, as well as to more senior exceptionally qualified candidates for appointment at higher ranks. We are interested in a broad spectrum of computational plasma physics areas, including fundamental plasma physics, geospace, solar, heliospheric and astrophysical plasma physics, plasma fusion, and plasma device modeling. Candidates are sought who combine an outstanding research record with a strong commitment to undergraduate and graduate teaching and mentoring. The successful candidate is expected to complement and expand existing theoretical and experimental efforts; please visit physics.dartmouth.edu for additional information. Application material (including: cover letter; current CV with publication record; statement of research interests and plans; statement of teaching interests; complete contact information of at least three professional references) should be submitted electronically to apply.interfolio.com/31594. Application review will begin on January 11, 2016, and continue until the position is filled. Dartmouth College is an equal opportunity/affirmative action employer with a strong commitment to diversity. In that spirit, we are particularly interested in receiving applications from a broad spectrum of people, including women, minorities, individuals with disabilities, veterans or any other legally protected group.

Interdisciplinary/Other

Assistant Professor of Geology and Geophysics Missouri University of Science and Technology

The Department of Geosciences and Geological and Petroleum Engineering invites applications for a full-time tenure-track faculty position in Geology and Geophysics at the Assistant Professor level in petroleum geology with expertise in carbonate reservoirs and basin analysis to begin in August, 2016. Review of applications will begin in November and continue until the search is completed. The successful candidate will be expected to develop an externally-funded research program integrated with excellence in teaching at both the graduate and undergraduate levels with a commitment to interdisciplinary work. Teaching responsibilities will include courses as part of degree requirements as well as in the candidate's area of expertise. The Department currently has 20 full-time faculty, and 371 undergraduate and 309 graduate degree-seeking students with established B.S., M.S., and Ph.D. programs in Geology & Geophysics, Petroleum Engineering, and Geological Engineering. Closely associated departments include Environmental Engineering and Mining Engineering. Local area establishments with active research include the U.S. Geological Survey (Mid-continent Geospatial Mapping Center), Missouri Department of Natural Resources, Fort Leonard Wood, the Missouri S&T Rock Mechanics and Explosives Research Center, Materials Research Center, and Energy Research and Development Center. Interested applicants should submit a cover letter, a current curriculum vitae, a statement of research and teaching interests and experience, and complete contact information for four references electronically to the Missouri University of Science and Technology's Human Resource Office at http://hr.mst.edu/careers/academic/. Applicants should ask for Position Number 00031149 to be included on each reference sent directly to the chair of the search committee, Dr. Wan Yang (yangwa@mst.edu). The final candidate is required to provide copies of official transcript(s) for any college degree(s) listed in application materials submitted, prior to the start of employment. In addition, the final candidate may be required to verify other credentials listed in application materials. Failure to do so may result in the withdrawal of the job offer. All job offers are contingent upon successful completion of a criminal background check. The University of Missouri is an equal access, equal opportunity, affirmative action employer that is fully committed to achieving a diverse faculty and staff. Equal Opportunity is and shall be provided for all employees and applicants for employment on the basis of their demonstrated ability and competence without unlawful discrimination on the basis of their race, color, national origin, ancestry, religion, sex, sexual

ETH zürich

Professor or Assistant Professor (Tenure Track) of Experimental Geochemistry/ Mineral Physics

→ The Department of Earth Sciences (www.erdw.ethz.ch) at ETH Zurich invites applications for the above-mentioned position at the full, associate or assistant professor level.

→ The professorship offers long-term funding to establish new laboratories and a dynamic research team, at the core of an innovative research program directed at the fundamental understanding of the properties and behavior of Earth materials from the atomic to the global scale. The program includes experiments at elevated temperatures and pressures and may be complemented by in-situ observations of natural and experimental materials (e.g. synchrotron and other microbeam methods) and/or theoretical modelling of physical chemistry. Potential fields of research include the physical properties of crystalline substances, the transport properties and physical chemistry of melts and fluids, the kinetics of phase transitions or the characterization of isotopic fractionations operating from the interior to the surface of planets.

→ The successful candidate is an experimental geochemist or mineral physicist, who will combine experimentation at high pressures and temperatures with complementary theoretical investigations. He or she is a leading scientist exploring the atomic-scale structure and the physical and chemical properties of solids, melts or fluids, with the aim of understanding the internal dynamics of the Earth and other planets. The new professor and her/his research group will be expected to contribute to introductory and advanced courses on crystallography, mineralogy and the physical chemistry of materials at the Earth's surface and interior as well as to teach undergraduate level courses (German or English) and graduate level courses (English).

→ An assistant professorship promotes the careers of younger scientists. The initial appointment is for four years with the possibility of renewal for an additional three-year period and promotion to a permanent position.

→ Details regarding the application procedure and required documents can be found at www.erdw.ethz.ch/en/department/jobs/professorships. Please submit your application addressed to the **President of ETH Zurich, Prof. Dr. Lino Guzzella online at www.facultyaffairs.ethz.ch.** ETH Zurich is an equal opportunity and family friendly employer and is further responsive to the needs of dual career couples. We specifically encourage women to apply.

orientation, gender identity, gender expression, age, genetic information, disability, or protected veteran status.

CLIMATOLOGY OR GEOHYDROLOGY AT BINGHAMTON UNIVERISTY

Binghamton University will make one tenure-track appointment in the area of climatology or geohydrology starting Fall, 2016. We seek a geoscientist who uses some combination of field measurements, observations and modeling. Appointments are planned at the assistant professor level, however exceptionally qualified applicants may be considered for a higher level appointment.

In the area of climatology we are seeking a geoscientist studying global-scale energy exchange within the Earth System. Possible research areas might include: (1) past, present and future climate change; (2) understanding modern climate systems to interpret paleoclimate archives preserved in ice and sediments, and to predict future climate changes; (3) the dynamics of sea-level changes as ice sheets respond to changing energy levels in the atmosphere and oceans; (4) impact of climate variations on renewable energy resources; and (5) impacts of climate change on ecosystems and human health. Geoscientists with other research areas in the broad field of climatology are also encouraged to apply.

In the area of geohydrology we are seeking a geoscientist studying physical, chemical or biological processes involving surface water or groundwater. Possible research areas might include: (1) chemical evolution or recent contamination of Earth's surface and subsurface water; (2) flow and transport modeling in granular or fractured media; (3) microbial processes and their effect on solute transport; and (4) hydrogeology of energy resources. Geoscientists with other research areas in the broad field of geohydrology are also encouraged to apply.

The successful candidate must develop and sustain a nationally-recognized, externally-funded research program in their area. We also expect the candidate to develop a strong record of teaching and mentoring students and to teach undergraduate courses and advanced undergraduate/graduate level courses in their area of expertise. We are seeking candidates who will strengthen our existing research programs in geochemistry, sedimentary geology, or Earth surface processes, and who will seek to interact with geologists, environmental scientists, chemists, physicists and engineers on the Binghamton University campus. Candidates must have a Ph.D. with a focus in either of these fields at the time of appointment. Interested candidates should submit a letter of application, curriculum vitae, statements of research and teaching interests, and names and contact information of at least three references to the Binghamton University Interview Exchange site at http://binghamton.interviewexchange.com. For further information about the department, visit the Geological Sciences and Environmental Studies website (www.geology.binghamton.edu). Climatology candidates may contact Professor Tim Lowenstein (lowenst@binghamton.edu) whereas geohydrology candidates may contact Professor Bob Demicco (demicco@binghamton.edu).

This position is affiliated with the Sustainable Communities Area, one of five Transdisciplinary Areas of Excellence (TAEs) that Binghamton University has identified for growth under the auspices of the SUNY2020 plan. The successful candidate will contribute to the development of this TAE as an area of intensive research and teaching. The search committee will include members of the Sustainable Communities TAE steering committee. For more information on the TAEs [and SUNY2020], go to http://www.binghamton.edu/tae/. Women and minorities are encouraged to apply. Binghamton University is an equal opportunity/affirmative action employer. The position will remain open until filled. The review of applications will begin on November 30, 2015.

Lecturer Faculty Position Geoscience

The Department of Geology and Environmental Earth Science at Miami University invites applications for a full-time Lecturer faculty position on the Oxford campus, beginning August 2016. The Lecturer will teach undergraduate courses, including foundation courses in physical and environmental geology, as well as intermediate level courses; advise undergraduate students; provide professional service to the department and university. Required: M.S. in geoscience by date of appointment and documented teaching experience. Desired: Ph.D. in geoscience with interest in contributing to supervision of undergraduate student research and field-based experiences. Submit cover letter, vitae, statement of teaching philosophy and experience, unofficial copy of transcripts, and names of three (3) referees to https://miamioh.hiretouch.com/job-details?jobID=1874. Letters of reference will be requested upon receipt of application. Inquiries can be directed to Cathy Edwards at edwardca@miamioh.edu. Review of applications will begin on January 15, 2016 and continue until position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation.

Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required. All campuses are smoke- and tobacco-free.

Marshall-Heape Chair in Geology

The Department of Earth and Environmental Sciences at Tulane University invites applications for the newly established Marshall-Heape Chair in Geology. We seek a scholar with an outstanding international reputation who will be appointed at the Full Professor level with tenure. We particularly seek a broad-based Earth scientist who complements current faculty expertise and offers potential for collaborative research. The Marshall-Heape Chair is expected to lead a widely recognized, externally funded research program that will attract PhD-level graduate students and postdoctoral scholars of the highest caliber. Teaching duties are both at the graduate and undergraduate levels. For full consideration, applications should be received by January 10, 2016, but the position will remain open until filled. Applications should include a curriculum vitae, research and teaching statements that articulate how the mission of the department would be enhanced, and the names and contact information of at least three references. Applications must be submitted electronically via the following link: apply.interfolio.com/31900. Any inquiries may be directed to Dr. Torbjörn Törnqvist, Department of Earth and Environmental Sciences, Tulane University, 6823 St. Charles Ave., New Orleans, LA 70118-5698 (tor@tulane.edu). Further information about the department and university can be obtained at http://tulane.edu/sse/eens. Tulane University is an EEO/ADA/AA employe

TENURE-TRACK FACULTY POSITION - ASSISTANT PROFESSOR, DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES, SAINT LOUIS UNIVERSITY

Saint Louis University, a Catholic, Jesuit institution dedicated to student learning, research, health care, and service invites applications for a tenure-track faculty position in Geoscience at the Assistant Professor level in the Department of Earth and Atmospheric Sciences (EAS), to begin in August, 2016.

We seek applicants with expertise in geomorphology in any of the following areas: rivers and streams, floodplains, or hillslopes. Faculty responsibilities include a balance of research, teaching, service, and the mentoring of undergraduate and graduate students. Teaching responsibilities include undergraduate courses in surface processes and field methods, and graduate courses in the candidate's area of expertise. We seek an individual who values collaboration, field-based research, teaching, and collegiality. A PhD in earth science or a related field is required at the time of appointment. Post doctoral experience is highly desirable.

Department programs include undergraduate degrees in environmental science, environmental studies, geology, geophysics, and meteorology. The department grants MS and PhD degrees in geoscience (with concentrations in geology, geophysics, and environmental geoscience) as well as in meteorology. Faculty may also participate in the interdepartmental Integrated and Applied Sciences PhD program. For more details, visit the EAS website (www.slu.edu/x35834.xml). Outside of the department, there is opportunity for collaboration with other university departments and units including the Center for Sustainability (http://www.slu.edu/sustainability) and the Parks College of Engineering, Aviation and Technology (http://parks.slu.edu/). Additional information can be found at www.slu.edu.

All applications must be made online at https://jobs.slu.edu and must include a cover letter, curriculum vitae, a two-page statement of teaching, research, and professional goals, and the names and complete contact information of at least four references. Review of applications will begin 1 November and will continue until the position is filled. Inquiries may be sent to geosearch@eas.slu.edu.

Saint Louis University is an Affirmative Action, Equal Opportunity Employer (AA/EOE), and encourages nomination and application of women and minorities

The O.K. Earl Postdoctoral Fellowship and the Texaco Postdoctoral Fellowship

The California Institute of Technology announces two one-year fellowships in Geological and Planetary Sciences beginning with the 2016-17 Fall term. The O.K. Earl and Texaco Postdoctoral Fellowships are awards funded by endowments from Orrin K. Earl, Jr. and the Texaco Philanthropic Foundation. Each fellowship carries an annual stipend of $62,000 plus a research expense fund of $5,000, and one-way travel costs to Pasadena. Completion of the Ph.D. is required. Fellows are eligible to participate in Caltech's health and dental program.

For fellowship details and to apply online, please visit: https://applications.caltech.edu/job/gpspd

Materials in support of an application should include curriculum vitae, list of publications, a one-page statement of research interests, and three letters of reference. Applications and references are due by December 1, 2015.

ETH zürich

Professor or Assistant Professor (Tenure Track) of Climate Geology

→ The Department of Earth Sciences (www.erdw.ethz.ch) at ETH Zurich invites applications for the above-mentioned position at the full, associate or assistant professor level.

→ The successful candidate is a leading scientist investigating climates of the geological past. He or she is expected to build a vigorous research program aimed at understanding climate and climate changes on timescales from millennia to geological epochs, using geological or geochemical approaches and modern analytical techniques. The research program may, for example, focus on the coupling between climate and terrestrial and oceanic systems, the development and exploitation of climate proxies from the marine sediment record, or climate changes during mass extinction events. Ideally, the future professor would complement existing strengths in the geosciences and climate sciences at ETH Zurich. The teaching portfolio is expected to include undergraduate classes in Earth system sciences, sedimentology and participation in our field program; more advanced graduate classes may cover aspects of Earth's climate, Earth history, and the use of proxies for inferences about past climates. The new professor will be expected to teach undergraduate level courses (German or English) and graduate level courses (English).

→ An assistant professorship promotes the careers of younger scientists. The initial appointment is for four years with the possibility of renewal for an additional three-year period and promotion to a permanent position.

→ Details regarding the application procedure and required documents can be found at www.erdw.ethz.ch/en/department/jobs/professorships. Please submit your application addressed to the **President of ETH Zurich, Prof. Dr. Lino Guzzella online at www.facultyaffairs.ethz.ch**. ETH Zurich is an equal opportunity and family friendly employer and is further responsive to the needs of dual career couples. We specifically encourage women to apply.

EOE of Minorities/Females/Protected Vets/Disability

The Roy M. Huffington Department of Earth Sciences at SMU announces a search to fill a named tenure-track or tenured professorship (the rank is open) honoring WB Hamilton.

We solicit nominations and applications from earth scientists who maintain vigorous and sustainable research programs and who have a commitment to full participation in the educational mission of the department to provide professional training in a liberal arts environment. As the fourth holder of the chair established in 1921, the successful candidate will extend existing departmental strengths in earth science. The department's focus is on pure research to understand Earth history and geologic processes with applied research on problems in the national interest such as climate and environmental change, earthquake seismology including induced seismicity, natural hazards, nuclear test ban monitoring and resources including geothermal energy. The expected start date is August 1, 2016.

Applications can be submitted electronically to sschwob@smu.edu or in writing to:

Professor John Walther

Search Committee Chair, Department of Earth Sciences,

Southern Methodist University, P.O. Box 0395

Dallas TX 75275

Applicants should include curriculum vitae, statements of research and teaching interests, and contact information for three references. To insure full consideration applications must be received by December 5, 2015, but the committee will continue to accept applications until the position is filled. The committee will notify applicants of its employment decisions after the position is filled.

Southern Methodist University will not discriminate in any program or activity on the basis of race, color, religion, national origin, sex, age, disability, genetic information, veteran status, sexual orientation, or gender identity and expression. The Executive Director for Access and Equity/Title IX Coordinator is designated to handle inquiries regarding nondiscrimination policies and may be reached at the Perkins Administration Building, Room 204, 6425 Boaz Lane, Dallas, TX 75205, 214-768-3601, accessequity@smu.edu.

Hiring is contingent upon the satisfactory completion of a background check.

UNIVERSITY OF CALIFORNIA SANTA BARBARA,

The Earth Research Institute invites applications for a tenure-track faculty position in Climate Dynamics at the Assistant Professor level. Candidates must have primary research and teaching interests in climate dynamics over human-relevant time scales with focus on understanding mechanisms of natural climate variability and/or anthropogenic climate change on decadal to multi-centennial timescales. An

EO/AA Employer. For more information and to apply: at https://recruit.ap.ucsb.edu/apply/JPF00559

Visiting Assistant or Associate Professor in Petrology and Mineralogy, Texas A&M University, Department of Geology and Geophysics

The Department of Geology and Geophysics at Texas A&M University invites applications for a full-time, non-tenure track position at the rank of Visiting Assistant or Associate Professor to teach courses in Petrology, Mineralogy, and Mineral Resources. The position is a nine-month appointment beginning January 1, 2016 contingently renewable for up to three years. Responsibilities consist of teaching at least four courses per academic year in some combination of Mineralogy, Petrology, and/or Mineral Resources. The department will support the successful candidate's pursuit of independent research and development of a professional academic portfolio, with the opportunity to collaborate with students and colleagues in the College of Geosciences, including the Berg-Hughes Center for Sedimentary and Petroleum Systems, the Center for Tectonophysics and the Deep Crust and Mantle Group. For more information about TAMU, the College of Geosciences and the Department of Geology and Geophysics, see http://geoweb.tamu.edu/

A PhD with specialization in mineralogy or petrology at the time of appointment is required, but ABD candidates also will be considered. Interested candidates should submit electronic versions of a curriculum vita, statement of research interests and teaching philosophy, the names and email addresses of at least three references, and up to four reprints by email attachments, to the Chair of the Mineralogy/Petrology Search Committee (petrosearch@geos.tamu.edu). Screening of applications will begin November 1, 2015 and continue until a suitable candidate is appointed. The Department of Geology and Geophysics is part of the College of Geosciences, which also includes the Departments of Atmospheric Sciences, Geography, and Oceanography, Sea Grant, the Geochemical and Environmental Research Group (GERG), and the Integrated Ocean Drilling Program (IODP). Texas A&M University, a land-, sea-, and space-grant university is located in a metropolitan area with a dynamic and international community of 172,000 people. Texas A&M University is an affirmative action/equal opportunity employer committed to excellence through the recruitment and retention of a diverse faculty and student body and compliance with the American with Disabilities Act. We encourage applications from minorities, women, veterans, and persons with disabilities. Texas A&M University also has a policy of being responsive to the needs of dual-career partners.

Visiting Instructor / Visiting Assistant Professor Hydrogeology

The Department of Geology and Environmental Earth Science at Miami University invites applications for a temporary, full-time faculty position on the Oxford campus, beginning August 2016. This is a nine-month (two academic semester) appointment that may be renewed for up to four years pending funding availability and satisfactory performance. The primary responsibility of this position is teaching, including foundation courses in physical and environmental geology, and intermediate and upper level courses such as Water & Society and Hydrogeology. An M.S. in geology or a related field is required for appointment as Instructor; a Ph.D. is preferred and is required for appointment as a Visiting Assistant Professor. Submit cover letter, vitae, statement of teaching philosophy and experience, unofficial copy of transcripts, and 3 letters to reference to https://miamioh.hiretouch.com/job-details?jobID=1862. Inquiries can be directed to Cathy

Edwards at edwardca@miamioh.edu. Review of applications will begin on January 15, 2016 and continue until position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required. All campuses are smoke- and tobacco-free.

West Virginia University, Department of Geology & Geography: Three Assistant Professor Positions

The Department of Geology and Geography at West Virginia University seeks to fill three geology faculty positions. Applicants should have a PhD or equivalent degree in geology, earth science or related field by the start date. Review of applications for all positions will begin January 15, 2016 and continue until each position is filled; start date for all positions is August 15, 2016.

Paleobiology: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in Paleobiology, which could include expertise in Invertebrate or Vertebrate Paleontol-

Lamont Doherty Earth Observatory

COLUMBIA UNIVERSITY | EARTH INSTITUTE

Lamont Research Professors

Lamont-Doherty Earth Observatory (LDEO) of Columbia University anticipates appointing one or more **Lamont Research Professors** (open rank) in the Earth sciences. Lamont Research Professors receive nine-month appointments with partial salary support provided from institutional sources. An incentive program encourages the establishment of an externally funded research program to provide the majority of salary support. Applicants for Associate and Full Research Professor ranks should have established records of innovative research of high impact evidenced by publications, and should have demonstrated success at raising external support for their research programs. Applicants for the rank of Assistant Research Professor should have demonstrated potential for significant research contributions through publications, and potential for supporting their research programs with external funding. LDEO is particularly interested in applicants who will expand our expertise in the following areas:

- Dynamics of hydrometeorological systems, particularly extreme events and their impacts
- Real-time observational geoscience, with an emphasis on applications of new sensor and information technologies to fundamental processes at all scales
- Dynamics and kinematics of the solid Earth, with a focus on earthquake and volcanic processes and associated modes of crustal deformation and crust-mantle coupling
- Climate and paleoclimate studies, including coupled climate, ocean, and terrestrial ecosystems
- Studies of the cryosphere and sea-level

Eligibility requirements: Ph.D. in Earth and environmental sciences or related field, evidence of ongoing externally funded research programs or potential for supporting research programs with external funding, and at least 2–3 years of relevant research experience. Salary will be commensurate with experience. Interested candidates should apply online at the following link: https://academicjobs.columbia.edu/applicants/Central?quickFind=61597.
Evaluation of applications will begin after 15 November 2015.

For more information contact: Office of the Director
Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 10964
Telephone: 845-365-8546 • Fax: 845-365-8162 • Email: director@ldeo.columbia.edu

Lamont-Doherty Earth Observatory is committed to diversity. Columbia University is an Equal Opportunity/Affirmative Action – Race/Gender/Disability/Veterans Employer.

ogy, Micropaleontology, Paleoecology, Paleobotany/Palynology, Ichnology, or related fields. The successful candidate will be expected to develop a vigorous externally-funded research program, teach core undergraduate classes in paleontology, graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Paleobiology@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/Paleobiology or contact the search chair, Amy Weislogel, at Paleobiology@mail.wvu.edu or (304) 293-6721.

Quantitative Structural Geology or Geomechanics: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in quantitative structural geology with interests in the study of fractured reservoirs and geomechanics. The successful candidate will be expected to develop a vigorous externally-funded research program, teach undergraduate classes in structural geology or geomechanics, teach graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Geomechanics@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/Geomechanics or contact the search chair, Dengliang Gao, at Geomechanics@mail.wvu.edu or (304) 293-3310.

Teaching Assistant Professor of Geology: We seek to hire a full-time (9-month), non-tenure track Teaching Assistant Professor. The successful candidate will teach a variety of undergraduate courses, including both large introductory and smaller upper-division classes, in the classroom and online, and the field component of the B.S. capstone course, Geology Field Camp (the last with an additional summer stipend). Specialty area is open. Teaching Assistant Professors at WVU are eligible for promotion; however, promotion to senior ranks is not a requirement for institutional commitment and career stability. This position is a nine-month renewable appointment (no maximum number of terms) and includes full benefits. The position carries an 80% teaching (4 courses per semester) and 20% service assignment. The successful candidate will join a faculty that takes great pride in having members recognized at the university, state, and national levels for excellence in teaching. The Department occupies the recently renovated Brooks Hall with state-of-the-art teaching technologies and facilities. To apply for this position, interested candidates should visit jobs.wvu.edu and navigate to the position title listed above. Upload a single PDF file containing a curriculum vitae, statement of teaching interests and philosophy, teaching evaluations as available, and full contact information for 3 references. In addition, please arrange for three letters of reference to be sent directly to GeologyTAP@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/GeologyTAP or contact the search chair, Thomas Kammer, at GeologyTAP@mail.wvu.edu or (304) 293-9663.

WVU is an EEO/Affirmative Action Employer and welcomes applications from all qualified individuals, including minorities, females, individuals with disabilities, and veterans. For additional information about the department visit www.geo.wvu.edu.

Student Opportunities

EarthCube's Visiting Scientist Program offers up to $2000 each to support five graduate students and early career scientists for travel and related expenses incurred while incorporating EarthCube technologies and capabilities in their own research agendas.

For more information or to apply for funding, please go to:
http://earthcube.org/info/visiting-scholar-program

Funded PhD opportunities in water resources at the Univ. of Idaho through the NSF's IGERT program. Seeking applicants with backgrounds in hydrology, environmental science, ecohydraulics, fisheries science, water resources engineering, climate science, ecology, sociology, rural and community economics, or public policy interested in integrating team-based science and applications. Contact Mary Schierman, marys@uidaho.edu for more info. or www.uidaho.edu/igert. Applications due Nov. 15, 2015.

Graduate Assistantships in Environmental Chemistry/ State University of New York-Environmental Science and Forestry (SUNY-ESF).

The Department of Chemistry offers graduate assistantships to students pursuing M.S. or Ph.D. degrees in environmental chemistry.

Research in the department spans a wide range, from field work to laboratory work to computer modeling, and from global biogeochemical cycles to ecosystems to air and water pollution.

For more information, see http://www.esf.edu/chemistry/

PhD Student Opportunity in Hydrology, Washington State University

Four year RA available for student to work with an interdisciplinary team to understand the interactions between drought, forest management, and wildfire on forest ecosystem resilience. Students experienced with Linux/programming and/or ecohydrology will be competitive. The student will be co-advised by Jennifer Adam (WSU} and Christina Tague {UCSB}. Interested students should contact jcadam@wsu.edu for more information. Fall semester applications to WSU are due on 10 January for priority consideration.

Postdoctoral Research Associate in the Department of Earth and Environmental Science at the University of Pennsylvania.

We seek an individual with experience in studying impact-induced melting and deformation in rocks to investigate rock fulgurites, which result from lightning strikes. The successful candidate will apply modeling, theoretical and/or experimental approaches to understanding the formation of fulgurites and associated shock microstructures, and will work closely with mineralogists and geochemists in our department to inform models and theory with microstructural observations. A key goal will be to understand similarities and differences between shock-induced planar deformation features in fulgurites and similar features in rocks deformed by meteoric impacts or experimental shock loads.

The position is available for one year and may be renewable based on performance and the further availability of research funds.

Please send a letter of interest, CV, and the names and contact information of 3 references to Prof. David Goldsby (dgoldsby@sas.upenn.edu) or Prof. Reto Gieré (giere@sas.upenn.edu). Evaluation of applications will begin immediately and continue until the position is filled. Penn is an affirmative action, equal opportunity employer.

Postcards from the Field

Hello, everyone,

Dust storms are a real problem here in Southern Iceland, and the weather has been perfect for us to collect samples. It's cold, dry, and windy. The wind blows across the vast expanses of black sand beaches, transporting dust as far as #Reykjavik, reducing the air quality. We are determining how much dust is transported, as well as the size of the particles, which is important for understanding impacts on human health. Here, you can see @TWMockford collecting samples from the Big Spring Number Eights (BSNEs).

Want to know more about high latitude and cold climate dust? Check out the network's page at http://www.hlccd.org.

Eleanor Darlington,
Researcher at Loughborough University, UK
@efdarlington

View more postcards at *http://americangeophysicalunion.tumblr.com/tagged/postcards-from-the-field.*

Apply for Amazon Web Services Research Grants Online During the AGU Fall Meeting

Visit AWS at Booth #516

amazon web services

AGU
American Geophysical Union

Amazon Web Services and AGU are excited to announce a special Live Granting of Amazon Web Services research grants at the 2015 Fall Meeting.

Applications will be accepted and evaluated 20 October–31 December 2015 with the opportunity for live applications and granting at the AWS booth (#516) during the Fall Meeting. Grants will be awarded during and following the Fall Meeting.

Visit **FallMeeting.agu.org/2015/AWSLiveGranting** for more information and to apply.

AGU CHAPMAN CONFERENCE

Ixtapa, Guerrero, Mexico | 21-25 February 2016

AGU Chapman Conference on the Slow Slip Phenomena

Abstract Submission Deadline: 18 November
Housing Deadline: 29 January

Join your colleagues to examine and discuss these phenomena on a global level.

Topics include:

- Observations of slow slip phenomena
- Fault structure and physical conditions where slow earthquakes are observed
- Slow earthquakes and their relationship to large earthquakes and seismic hazard
- Models and laboratory experiments
- Improving observational methods for the analysis of slow slip phenomena

chapman.agu.org/slowslip